K.7
12/02

U.S. Environmental Protection Agency

Supplemental Site Investigations/ Site Characterization Report Himco Dump Superfund Site Elkhart, Indiana

Final

Volume 1 of 4
Text, Tables, and Figures

December 2002

Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government

HIMCO DUMP SUPERFUND SITE
ELKHART, INDIANA

TABLE OF CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

ABS	Absorption Fraction
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below Ground Surface
BRA	Baseline Risk Assessment
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
°C	Degrees Celsius
CDA	Construction Debris Area
CDI	Chronic Daily Intake
CEC	Cation Exchange Capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGI	Combustible Gas Indicator
CLP	Contract Laboratory Program
COPC	Chemicals of Potential Concern
CRL	Central Regional Laboratory
CRQL	Contract-Required Quantitation Limit
CSM	Conceptual Site Model
CT	Central Tendency
DO	Dissolved Oxygen
EA	Eastern Off-Site Residential Assessment
EPC	Exposure Point Concentration
eV	Electron Volt
FID	Flame Ionization Detector
FIT	Field Investigation Team
FS	Feasibility Study
FSP	Field Sampling Plan
GAF	Gastrointestinal Absorption Factor
gpm	Gallons per Minute
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
Himco	Himco Dump Superfund Site
HQ	Hazard Quotient
IEUBK	Integrated Exposure Uptake Biokinetic
ILCR	Incremental Lifetime Cancer Risk
IRIS	Integrated Risk Information System
ISBH	Indiana State Board of Health
K_{ow}	Octanol/Water Partition Coefficient
K_p	Permeability Coefficient
LEL	Lower Explosive Limit
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter

mL	Milliliter
ml/min	Milliliter per Minute
MSL	Mean Sea Level
NCP	National Contingency Plan
NFG	National Functional Guidelines
ng	Nanograms
NPL	National Priorities List
NTU	Nephelometric Turbidity Unit
ORP	Oxidation/Reduction Potential
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PEF	Particulate Emission Factor
PID	Photoionization Detector
ppm	Parts per Million
PRG	Preliminary Remediation Goal
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAGS	Risk Assessment Guidance for Superfund
RAS	Routine Analytical Services
RBSL	Risk-Based Screening Level
RD	Remedial Design
RDA	Recommended Daily Allowance
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPD	Relative Percent Difference
SARA	Superfund Amendments and Reauthorization Act
SEC	Specific electrical conductance
SFW	Water Skin Contact Factor
SOW	Statement of Work
SQL	Sample Quantitation Limit
SRA	Supplemental Risk Assessment
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TEF	Toxicity Equivalency Factor

TIC	Tentatively Identified Compound
TOC	Total Organic Carbon
µg/kg	Micrograms per Kilogram
µg/l	Micrograms per Liter
$\mu g/m^3$	Micrograms per Cubic Meter
µs/cm	Microsiemens per Centimeter
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

The Himco Dump Superfund Site, located adjacent to the City of Elkhart in Elkhart County, Indiana was used to dump and landfill waste for approximately 16 years, ending in 1976. The area was designated a Superfund Site in 1988. At this time, an environmental investigation was initiated to determine the nature and extent of contamination due to the disposal activities. As part of this investigation, a human health risk assessment that quantified potential health risks due to exposure to various media at the site was prepared, including a recommendation for remedial action, and identification of data gaps. Several investigations followed during the next ten years, each designed to fill a specific data need. By 1999, it became clear that the fragmented data sets should be consolidated into one report and the body of information used to update decisions for the site. This Supplemental Site Investigations/Site Characterization Report has been prepared to:

- Summarize previously published site ground water analytical data generated between 1978 and 1995.
- Present unpublished site ground water analytical data collected during three supplemental site investigations conducted in 1996, 1998, and 2000, present soil analytical data collected in 1998 from the area immediately adjacent to the southern perimeter of the site known as the Construction Debris Area (CDA), and present site soil gas analytical data collected from the southern and eastern perimeter of the site between 1998 and 1999.
- Provide an updated assessment of risk due to exposure to ground water that incorporates results of all ground water data collected between 1978 and 2000 and quantify the risk from exposure to soil located within the CDA.

Site Features

The Himco Dump Site encompasses a closed landfill which operated from approximately 1960 to 1976 at a location adjacent to County Road 10 and John Weaver Parkway outside the city of Elkhart, Indiana. The landfill and surrounding areas were initially marsh and grassland. There was no liner, leachate collection, or gas recovery system constructed as part of the landfill. Refuse was placed at ground surface across the site, with the exception of five trenches 10 to 15 feet deep and 30 feet long that were excavated in the eastern area of the site.

The CDA bordering the southern perimeter of the landfill consists of construction rubble mixed with non-native soil. Numerous small piles of rubble, concrete, asphalt, and metal debris are scattered throughout this area. The CDA is approximately 4 acres in size and is subdivided into seven residential and one commercial property parcels. The residential parcels are currently occupied. The existing homes on these residential parcels were connected to a municipal water supply during an earlier action, however, some of the homes also have operable water wells. The commercial property is not currently occupied or being used for any purpose.

Site Investigation History

Numerous site investigations of varying complexity have been performed in an attempt to evaluate the nature and extent of contamination associated with the Site. Five of the investigations were performed prior to the Record of Decision (ROD) publication in 1993. These investigations occurred in 1974 (Indiana State Board of Health Residential Well Sampling), 1981 (United States Geological Survey [USGS] Ground Water Evaluation), 1984 (United States Environmental Protection Agency [USEPA] Ground Water Evaluation), 1990 (USEPA Residential Well Evaluation), and 1992 (SEC Donohue Remedial Investigation/Feasibility Study). Subsequent to the ROD, five additional investigations were performed; in 1995 (United States Army Corps of Engineers [USACE] Pre-Design Field Investigation); in 1996 (USEPA Supplemental Site Investigation); in 1998 (USACE Supplemental Site Investigation); in 1999 (USACE Supplemental Site Investigation); and in 2000 (USEPA/USACE/USGS Supplemental Site Investigations). Often different media or locations were sampled during these investigations because they were performed in response to specific and different data gaps. One of the more recent data gaps identified was the lack of both data and an assessment of risk from exposure to the soil associated with the CDA south of the landfill. The risk assessment performed in 1992 as part of the Remedial Investigation/Feasibility Study estimated the risk from exposure to ground water and the landfill proper, but did not address the risk from exposure to soil associated with the CDA. Another identified data gap was the lack of information on the off-site migration of contaminants in the soil gas from the Site. While collecting the information to address the CDA and soil gas issues, other data gaps became evident. These included a lack of understanding of the long term ground water characteristics of the Site. The new ground water and CDA soil data collected from 1995 through 2000 were used to prepare a risk assessment to update the one prepared in 1992.

Summary of Site Characteristics

Waste in Place - The majority of the contaminant mass is located below the existing landfill cover, which consists of approximately one foot of sand overlying a calcium sulfate layer. Waste under the cover includes paper, plastic, rubber, wood, glass, metal (including wire, auto parts, pipes), and small amounts of hospital waste. About two-thirds of the waste in the landfill is reportedly calcium sulfate from Miles Laboratories, which may be leaching to ground water. As much as 360 tons/day were dumped over an unspecified time period. Except for the removal in May 1992 of seventy-one 55-gallon drums containing toluene and ethylbenzene, all waste originally disposed of remains on site.

Landfill Proper Soil - Forty-two surface soil samples and thirty-three subsurface soil samples were collected from the landfill cover and areas next to the cover during the Remedial Investigation performed in 1991-1992. These soil samples indicated the presence of arsenic as a site related surface soil contaminant across the western half of the site, around the quarry pond, south of the quarry pond and in south central area of the site. Volatile organic compounds (1,1-dichloroethane, tetrachloroethene, benzene, trichloroethene, ethylbenzene, benzene, toluene, and xylenes) were distributed at low levels (less than 140 ug/kg) in soil across the site and believed to be site related.

Semivolatile soil contamination (primarily polynuclear aromatic hydrocarbons) was most prominent in samples collected from the south central area characterized by non-native soil and construction debris.

Results of CDA Soil Analyses - Soil analytical data were collected from the Himco CDA during the 1998 Supplemental Site Investigation to characterize the nature of soil contamination in this area. A total of 18 soil borings located on 6 residential land parcels (residential land parcels D, F, M, O, P and S) were drilled and sampled. No soil borings were completed on four of the residential land parcels (residential land parcels N, Q, R and T). A geostatistical analysis was performed for the purpose of deriving estimated concentrations for the two primary chemicals of potential concern (COPC's), arsenic and benzo(a)pyrene, in soils for residential land parcels N, Q, R and T.

Several polynuclear aromatic hydrocarbons were detected in both surface and subsurface soil from sampling locations SB04, SB05, SB11 and SB13 through SB20. In addition, two semivolatile compounds (1,2-dichlorobenzene and 4-methylphenol) were detected at sampling locations SB16 and SB20, respectively. Each of the 23 target analyte list metals were detected at least once. Arsenic was detected at elevated levels in all soil samples. Lead and mercury were detected at elevated levels in one soil sample each, SB15-0.5 and SB20-0.5, respectively.

Ground Water Flow Directions - Water level surveys were completed in March and April 2000 to assist with the interpretation of ground water flow directions at different depths within the aquifer beneath the Site. The depth to ground water was obtained from 33 monitoring wells combined over these two water level surveys.

Contour plots of April 2000 ground water elevation data from shallow (screened across or within approximately 30 feet below the water table) and intermediate (screened approximately 60 to 100 feet below ground surface) monitoring wells show ground water flow around the Site is predominantly to the south and southeast at this time period. There were an insufficient number of deep (screened greater than 100 feet below ground surface) monitoring wells to allow contouring of ground water elevation data for deeper levels of the aquifer. The overall direction of ground water flow reported in this document is consistent with other earlier published regional and site-specific interpretations of ground water elevation data.

Both upward and downward vertical gradients were observed in well clusters comprised of shallow/intermediate monitoring wells, with a predominance of downward gradients. These observations are not consistent with the results of the RI, and may reflect the influence of heavy rains which occurred during the April 2000 water level survey. The data base of well clusters has also increased considerably from the RI to the April 2000 water level survey. Upward vertical gradients were noted in all well clusters comprised of intermediate/deep aquifer monitoring wells. Monitoring wells set at greater depths most likely reflect the regional ground water flow system where ground water discharges to the St. Joseph River, and upward vertical flow dominates the system.

Results of Ground Water Sampling - The monitoring well sampling events performed in November 1996, October 1998, April/May 2000, and November 2000 are summarized in this report along with three residential water well sampling events that occurred between the months of March and November, 2000. Additionally, direct-push sampling, for vertical profiling, was performed in April/May 2000. Ground water samples were generally analyzed for Target Compound List (TCL) volatile organic compounds (VOC's) and semivolatile organic compounds (SVOC's), and total Target Analyte List (TAL) metals with a subset of analyses for pesticides, polychlorinated biphenyl's (PCB's), cyanide, bromide, sulfate and chloride.

- **1996 Supplemental Site Investigation Analytical Results** - Five ground water samples were collected and analyzed for TCL VOC's and SVOC's and total TAL metals, with the exception of the sample collected from well WT116A, which was sampled for VOC's only. Total 1,2-dichloroethene, 1,1-dichloroethane, 1,2-dichloropropane, trichloroethene, and benzene were detected. No SVOC's, including the polynuclear aromatic hydrocarbons detected in 1995 in a sample from well WT116A, were detected except for bis(2-ethylhexyl)phthalate. All of the TAL metals were detected at least once, except for antimony, beryllium, cadmium, lead, mercury, selenium and silver.

- **1998 Supplemental Site Investigation Analytical Results** - Seven ground water samples were collected and analyzed for TCL VOC's and SVOC's, and total TAL metals plus cyanide. 1,1-Dichloroethane was the only volatile organic compound detected during this sampling event. Diethylphthalate and bis(2-ethylhexyl)phthalate were the only SVOC's detected in this round of ground water sample collection. All of the TAL metals and cyanide were detected at least once except for cadmium, thallium, and vanadium.

- **March 2000 Residential Well Sampling** - Eleven residential well ground water samples were collected and analyzed for TCL VOC's and SVOC's, and total TAL metals. Six of the residential well samples were also analyzed for bromide and sulfate. The VOC's vinyl chloride, 1,2-dichloropropane, 1,1-dichloroethane, cis-1,2-dichloroethene, benzene, 1,2-dichloroethane, and chloroform were detected at least once. No SVOC's were detected. All of the TAL metals were detected at least once, except for aluminum, antimony, beryllium, cadmium, lead, mercury, selenium, silver, thallium and vanadium. Bromide was detected in all of the residential well samples at estimated concentrations; sulfate was also detected in all of the residential well samples.

- **April 2000 Residential Well Sampling** - Twelve residential well ground water samples were collected and analyzed for TCL VOC's and SVOC's, total TAL metals, bromide and sulfate. These results were comparable to those from the samples collected in March 2000, with the detection of the VOC's methylene chloride, 1,1-dichloroethane, cis-1,2-dichloroethene, 1,2-dichloropropane in at least one of the samples, and no detection of SVOC's. Except for aluminum, antimony, beryllium, cadmium, cobalt, mercury, selenium, silver, thallium and vanadium, all of the TAL metals were detected at least once, and the data compared well with

the previous results. Bromide was detected in all of the residential well samples at estimated concentrations. Sulfate was detected in all of the residential wells sampled except one.

- **November 2000 Residential Well Sampling** - Two residential well ground water samples were collected and analyzed for TCL VOC's and SVOC's, PCB's, pesticides, total TAL metals plus cyanide, bromide, sulfate and chloride. The VOC's ethyl ether, dichlorofluoromethane, 1,1-dichloroethane, cis-1,2-dichloroethene, 1,2-dichloroethane, and 1,2-dichloropropane were detected in at least one of the samples collected. Bis(2-ethylhexyl)phthalate was the only SVOC detected. No pesticides or PCB's were detected. All of the TAL metals were detected at least once, except for antimony, arsenic, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, thallium, and vanadium. Cyanide was not detected. Sulfate and chloride were detected in both samples collected.

- **2000 Monitoring Well Sampling** - Two rounds of monitoring well ground water samples were conducted in 2000. Twenty-nine ground water samples were collected in April/May 2000 and analyzed for TCL VOC's and SVOC's, total TAL metals, bromide and sulfate. Also, in conjunction with the USGS November 2000 study, two additional monitoring wells were sampled and analyzed for TCL VOC's and SVOC's, PCB's, pesticides, total TAL metals plus cyanide, bromide, sulfate, chloride, and the "Emerging Contaminants".

  The following discussion refers to the ground water analytical results obtained from the April/May 2000 sampling event. The VOC's vinyl chloride, 1,2-dichloropropane, chloroethane, 1,1-dichloroethane, cis-1,2-dichloroethene, benzene, tetrachloroethene and trichloroethene were detected in at least one well. The trihalomethanes (typical byproducts of water supply chlorination) chloroform, bromodichloromethane, dibromochloromethane and bromoform were also detected at least once. Butylbenzylphthalate, di-n-octylphthalate diethylphthalate, and bis(2-ethylhexyl)phthalate were the SVOC's detected. All of the TAL metals were detected at least once, except for antimony, beryllium and thallium. Metals data from monitoring wells WT102C, WT106A and WT115A should be used with caution as turbidity readings are questionable or are above 50 NTU's. Bromide was detected in all of the monitoring well samples, except WT113A. Sulfate was detected in all of the monitoring well samples.

  The following discussion refers to the ground water analytical results obtained from the November 2000 sampling event. The VOC's ethyl ether, dichlorofluoromethane, 1,1-dichloroethane and benzene, 1,2-dichloropropane were detected in at least one of the wells sampled. No SVOC's, pesticides or PCB's were detected. All of the TAL metals were detected at least once, except for antimony, beryllium, cadmium, chromium, mercury, nickel, selenium, silver, thallium, cyanide and vanadium. Bromide, sulfate and chloride were detected in both samples.

- **April/May 2000 Direct-Push Sampling** - Ten direct-push ground water samples from four locations were collected and analyzed for TCL VOC's and SVOC's, total TAL metals, bromide and sulfate. The VOC's chloroethane, carbon disulfide, 1,1-dichloroethane, cis-1,2-dichloroethene, 1,2-dichloropropane, trichloroethene, and benzene were detected in at least one of the samples collected. Bis(2-ethylhexyl)phthalate was detected in four of the ten samples. Phenol was detected in one sample. Except for antimony, beryllium, selenium, silver and thallium, all of the TAL metals were detected at least once. However, these data should be used with caution because the samples were very turbid. Bromide was detected in all of the samples at estimated concentrations and sulfate was also detected in all of the samples.

- **Emerging Contaminants** - In November 2000, one residential ground water well and two monitoring wells were sampled for analysis of "Emerging Contaminants". "Emerging Contaminants" is the term applied to pharmaceuticals, hormonal, and other organic wastewater contaminants that could be attributable to human or animal wastewater. The US Geological Survey (USGS) collected the samples, for information only, as part of a national reconnaissance using newly developed laboratory methods to provide baseline information on the environmental occurrence of these contaminants in ground water wells susceptible to animal or human waste sources.

Results of Soil Gas Analyses - Two supplemental soil gas investigations were performed between 1998 and 1999. The 1998 soil gas investigation concentrated primarily on the area south of the landfill to County Road 10, with limited investigations to the east of the landfill to John Weaver Parkway. A total of 43 soil gas samples were obtained during the first soil gas investigation. A total of 49 soil gas samples were obtained during the second (1999) soil gas investigation. Samples were obtained from areas east and southeast of the landfill boundary, extending out to the front yards of residences located east of the Himco Dump Site.

The soil gas investigations detected a large number of volatile organic compounds. The most predominant group, in terms of detected concentrations, were the chlorinated ethenes (tetrachloroethene, dichloroethene and vinyl chloride), followed in decreasing concentrations by the chlorinated ethanes (trichloroethane, dichloroethane and chloroethane), and benzene, toluene, ethylbenzene, and xylenes (BTEX). Several of the other compounds detected in the soils and/or leachate, and not detected in the soil gas have lower vapor pressures. All compounds appear to be distributed similarly with the more elevated concentrations found just off the south boundary of the landfill, and exhibiting a trend of decreasing concentrations as one moves away from the landfill perimeter. The fate and migration of these contaminants is dependent on the geologic conditions and the chemical properties of the contaminants. This pathway of exposure, based on the distribution of contaminants, is likely independent of the ground water migration pathway. In all cases, the highest detected concentrations are located in the southeast corner of the site just northwest of the intersection of County Road 10 and John Weaver Parkway. Overall, the limits of soil vapor contamination have been delineated with some minor exceptions. Two isolated detections of BTEX compounds were

found, one on the south side of County Road 10, and one on the east side of John Weaver Parkway. Three isolated detections of chlorinated ethenes/ethanes were also found on the east side of John Weaver Parkway.

Current and Future Potential Human Health Risks

The results of the human health risk assessment indicate a potential for risk to the following receptors if exposed to soil within the CDA or ground water migrating from of the site.

Age-Adjusted and Child Resident (Construction Debris Area) Potential risks to current and future residents who live to the south of the Himco landfill boundary and who may have exposure to surface and deeper soils in the CDA and to ground water from uncapped wells were evaluated. Ground water data collected from 1978 to 2000 were evaluated for usability in the risk evaluation. From this data set, total risk to residents living to the south of the Himco Dump from exposure to ground water for the southern perimeter was quantitatively evaluated using concentrations measured from the monitoring well pair MW116A/119A, combined with the risk from exposure to soil associated with the CDA.
The overall total potential carcinogenic risk to residents within the CDA ranged from 3.2 in 10,000 (3.2E-04) to 4.5 in 10,000 (4.5E-04); ground water pathways contribute the majority of the risk, with the remaining risk coming from soil pathways.

Incremental lifetime cancer risks (ILCR's) due to site-related chemicals in soil, estimated using the age-adjusted resident scenario (i.e., a 30 year exposure consisting of a child from 1-6 years and adult from 7-31 years), are greater than 1 in one million (1E-06) at all residential land parcels; they range from 1.9 in 100,000 (1.9E-05) to 1.5 in 10,000 (1.5E-04). The soil carcinogenic risks are attributable primarily to ingestion of and dermal contact with arsenic, benzo(a)pyrene and dibenz(a,h)anthracene. In addition, at all residential land parcels, inhalation exposure to benzene and vinyl chloride, and ingestion of arsenic, benzene, 1,2-dichloropropane and vinyl chloride contributed to a ground water risk of 3.0 in 10,000 (3.0E-04).

The potential total non carcinogenic risks to residents within the CDA, based on the child resident scenario (the more conservative noncarcinogenic assessment), ranged from a hazard index (HI) of 46 to 50. The estimated HI for the child resident exposed to ground water is 46 at all residential land parcels, and is primarily due to inhalation exposure to benzene and 1,2-dichloropropane, and ingestion of antimony, arsenic, iron, manganese, and thallium. The remaining HI of 0.11 to 4.5 is due to soil exposure, and is primarily due to ingestion of and dermal contact with antimony, arsenic, copper, manganese, and mercury. Two residential land parcels had estimated site-related HI's greater than 1 for the child resident exposed to soil. The estimated site-related HI from soil pathways for residential land parcel S is 2.9 (arsenic, antimony, copper, manganese) and for residential land parcel F is 4.5 (mercury).

At the Himco CDA, lead was detected above the residential screening level of 400 mg/kg (at an estimated concentration of 695 mg/kg) in one surface soil sample in residential land parcel F. Lead was also detected in other surface, near surface and subsurface soil samples at residential land parcels F, D, S and O; no soil samples were collected at residential land parcels N, R, Q and T, and soil concentrations in surrounding land parcels were projected into residential land parcels N, R, Q and T in order to evaluate the risk. Although the concentrations detected in the CDA land parcels were below the screening level, the concentrations represent lead concentrations in unsieved samples. It has been determined that lead is generally enriched in the fine particle fraction from sieved soil samples. Therefore, the total soil concentrations may be a likely underestimate of the overall risk from lead exposure in the identified parcels.

Construction Worker (Construction Debris Area) - The potential risks to a current or future construction worker, who is involved in a residential home improvement project, and who has exposure with soils, via ingestion, dermal contact, and inhalation (of particulates) during excavation and on-site activities conducted for 180 days over a nine month time-frame were evaluated.

For the construction worker, the estimated incremental lifetime cancer risks (ILCR's) due to site-related chemicals in soil at residential land parcels S, T, F, and D slightly exceed 1 in 1,000,000 (1E-06). The estimated risks to chemicals in the soil at residential land parcels S, T, F, and D are 1.7E-06, 4.6E-06, 7.1E-06, and 1.3E-06, respectively. An unacceptable noncancer hazard (Hazard Index [HI] > 1) to a current or future construction worker is possible in residential land parcel F (HI 1.3) and is primarily due to ingestion of and dermal contact with metals in soil.

The assessment only considered short term exposure such as would occur with a residential home improvement project. It did not consider potential health impacts to construction workers which could be imposed by major construction projects, such as new home construction or a large scale development which could occur under either the current or future land use.

Age-Adjusted Resident (Eastern Downgradient Ground Water) - Monitoring wells W T101A, WT114A, WT114B, and the direct-push sampling points GP16, GP101 and GP114 were chosen to evaluate the risk to residents living to the east of the Himco Dump from exposure to ground water from the eastern perimeter of the landfill. Samples were also taken from some of the residential wells east of the landfill; they exhibited concentrations of contaminants at, or higher than, concentrations found in monitoring wells. The contaminant concentrations exceeded risk screening levels and/or MCLs.

The estimated carcinogenic risk, using the age-adjusted resident scenario, to the adult resident east of the Himco Dump Site from exposure to ground water is 5.8 in 10,000 (5.8E-04). The risk is predominantly due to: 1) ingestion of arsenic [5.4 in 10,000 (5.4E-04)], and 2) inhalation exposure to benzene [2.0 in 100,000 (2.0E-05)] during household use.

Child Resident (Eastern Downgradient Ground Water) - The estimated noncarcinogenic risk to residents living east of the Himco Dump Site from exposure to ground water is a hazard index of 29. The child resident scenario was evaluated for the noncarcinogenic risks from exposure to ground water, because it is the most conservative scenario for the risk assessment. The site risk is predominately due to: 1) the child's inhalation exposure to benzene and 1,2-dichloropropane (HI = 4.4), and 2) the child's ingestion of arsenic, iron, manganese, and thallium (HI = 21). When the total HI from exposure to ground water is separated by target organ [(i.e. arsenic-skin, iron-liver, manganese-CNS (Central Nervous System), thallium and benzene-blood, and 1,2-dichloropropane-respiratory], all of the target organ HI's exceed an HI of 1.0.

Report Conclusions

The objectives to summarize all of the investigative data collected between 1978 and 2000 and to provide a quantitative assessment of risk due to ground water and CDA soils have been met in this report.

Analytical and risk data from these investigations demonstrate the need for the development of remedial designs and remedial actions. Ground water and landfill gas contaminants have migrated into the paths of adjacent southern and eastern residential areas, and the potential exists for the continued migration of contaminants into the ground water; the soil contaminants continue to exhibit a potential for human health risks from inhalation exposure.

Potential remedial options would include a landfill cover combined with an active landfill gas collection system. In addition, ground water controls should include long term monitoring of site ground water. Capping of residential water supply wells combined with connection to a municipal water distribution system should be considered for residents located immediately to the east of the Himco Dump site. Residents located to the south of the landfill have previously been provided with municipal water; however capping of remaining wells should be considered to prevent accidental ingestion/inhalation of ground water in this area. CDA soils have demonstrated a potential for risk to residents and workers from repeated exposure and should be removed.

1.0 INTRODUCTION

The Himco Dump Superfund Site (Site), located adjacent to the City of Elkhart in Elkhart County, Indiana, has been the subject of numerous site investigations to characterize the nature and extent of contamination associated with waste disposal activities. These investigations began in 1974, and have continued through 2000. Since 1978, various federal agencies starting with the United States Geological Survey (USGS), followed by the United States Environmental Protection Agency (USEPA) and the United States Army Corps of Engineers (USACE), have collected and published site analytical data for soil, sediment, leachate, residential basement gas, landfill waste mass gas (also referred to as soil gas), ground water and surface water. In June 1988, the site was proposed for the National Priorities List (NPL). This was followed by the start of the Remedial Investigation (RI) in 1989. By February 1990, the site was officially placed on the NPL and designated a Superfund Site. This Supplemental Site Investigations/Site Characterization Report has been prepared to summarize, in one document, the previously published ground water analytical data generated between 1978 and 1995, and to present unpublished ground water analytical data from three supplemental site investigations conducted in 1996, 1998, and 2000. This report also presents soil analytical data collected in 1998, and soil gas analytical data collected between 1998 and 1999. A summary of the sampling activities for all the supplemental site investigations is also presented herein. Human health risk assessments were completed to quantify the risk from exposure to soils located within the area immediately adjacent to the southern perimeter of the Site known as the Construction Debris Area (CDA), and from exposure to ground water by residences to the south and east of the Site. This report was completed for the USEPA Region 5 by the USACE Omaha District.

1.1 Site Background and Features

The Site encompasses a closed landfill which operated from approximately 1960 to 1976 at a location adjacent to County Road 10 and John Weaver Parkway (Nappanee Street Extension) in the City of Elkhart, Elkhart County, Indiana (Figures 1-1 and 1-2). The site is located approximately two miles north of the St. Joseph River, which runs east-west through the City of Elkhart. The site covers approximately 100 acres in the northeast quarter of Section 36, Township 38 North, Range 4 East, in Cleveland Township, of which approximately 58 acres were used as a landfill. The site is bounded on the north by woodlands, farm fields, and an abandoned gravel pit which is now a pond; on the west by two ponds and fields; on the south by County Road 10 and private residences; and on the east by John Weaver Parkway and private residences.

The landfill and surrounding areas were initially a marsh and grassland. There was no liner, leachate collection, or gas recovery system constructed as part of the landfill. Refuse was placed at ground surface across the site, with the exception of trench filling in the eastern area of the site. In this area, a total of five trenches 10 to 15 feet deep, the width of a truck and 30 feet long, were excavated. Paper refuse was reportedly dumped in the trenches and burned. The exact locations of these trenches within the landfill are unknown. About two-thirds of the waste in the landfill is reportedly calcium sulfate from Miles Laboratories. As much as 360 tons/day were dumped over an unspecified time

period. Other wastes accepted at the landfill included demolition/construction debris, household refuse, and industrial and hospital wastes. The landfill had no borrow source, but obtained sandy soil for daily cover from an abandoned gravel pit to the north, ponded areas to the west, and essentially anywhere around the perimeter of the site where sand was available. In 1976, the landfill was closed and covered. The cover consisted of approximately one foot of sand overlying a calcium sulfate layer.

The CDA bordering the southern perimeter of the landfill consists of construction rubble mixed with non-native soil. Numerous small piles of rubble, concrete, asphalt, and metal debris are scattered throughout the area; however, the calcium sulfate layer found at the landfill is not present in the CDA. The CDA is approximately 4 acres in size and is subdivided into seven residential and one commercial property parcels (Figure 1-2). The residential parcels are currently occupied. The existing homes on these residential parcels are connected to a municipal water supply; however, some of the homes also have operable water wells. The commercial property is not currently occupied or being used for any purpose. The CDA and it's boundaries are defined primarily from 13 test trenches excavated in 1991 during the second phase of field studies for the RI.

The abandoned gravel pit, commonly referred to as the quarry pond, is filled with water which is approximately 30 feet deep. The two other smaller and shallower ponds, on the west side of the site are commonly referred to as the "L" pond and the small pond.

A full discussion of the site background, history and physical characteristics of the Site is available in the *Final Remedial Investigation Report, Himco Dump Remedial Investigation/Feasibility Study*, published in August 1992 (Donohue, 1992). The study area under consideration in this Supplemental Site Investigations/Site Characterization Report for the Site is shown on Figure 1-1. This study area encompasses all of the monitoring wells used throughout the various investigations to monitor the ground water contaminant plume emanating from the Site, plus the appropriate background monitoring wells.

1.2 Population and Land Use

The population of the City of Elkhart is approximately 40,000. The city has an area of approximately 17 square miles. Within a one mile radius of the Site, land use is residential, commercial, industrial, and agricultural. Approximately one-third of the site itself has been used for soybean production, and corn is grown in the area.

1.3 Site Enforcement History

1971 - The Indiana State Board of Health (ISBH) first identified portions of the Site as an open landfill. In early 1974, residents along County Road 10 south of the Site complained to the ISBH about color, taste, and odor problems with their shallow wells. Analyses of six shallow residential wells along County Road 10 showed high levels of manganese.

1976 - The landfill was closed and covered. The cover consisted of approximately one foot of sand overlying a calcium sulfate layer.

1984 - A field investigation team (FIT) conducted a site inspection at the Site. Laboratory analysis from a number of the existing USGS monitoring wells showed that the ground water downgradient of the site was contaminated by volatile organic compounds (VOC's), semivolatile organic compounds (SVOC's) and metals. At the time of the FIT site inspection, leachate seeps were observed.

June 1988 - The Site was proposed for the NPL and in February 1990, was officially designated as a NPL site.

July 1989 - The USEPA issued a work assignment to SEC Donohue to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the Site. From 1990 through 1991, SEC Donohue conducted the RI/FS study for the site. Activities included waste characterization, geophysical surveys, test pit excavations, wetlands determination, installation of monitoring wells, and geochemical sampling of soils, sediment, leachate, surface water, ground water, landfill waste mass gas and residential basement gas.

During the RI/FS, a "hot spot" of contamination was identified in an area near the southwest border of the landfill proper just north of the CDA. A leachate sample from this area contained approximately 50% by weight toluene and other VOC's. The USEPA conducted a site assessment at the identified "hot spot" area in 1992 and verified a high level of VOC contamination. In response to this finding, the USEPA conducted an emergency removal action on May 22, 1992, which led to the identification and removal of seventy-one 55-gallon drums containing various liquids.

1993 - The USEPA signed the Record of Decision (ROD) for the site. The ROD, which is discussed in detail in the following section, prescribes the selected remedial action for the site.

1.4 Record of Decision

The purpose of the selected remedial action, as specified in the ROD, is to eliminate or reduce the migration of contaminants to ground water and to reduce risks associated with exposure to contaminated materials. The major elements of the remedial action per the ROD are listed below.

a. Construction of a composite barrier, solid waste landfill cover (cap) consisting of the following components:

- 18-inch thick vegetative soil layer,
- 6-inch thick sand drainage layer,
- 40-mil high density polyethylene (HDPE) flexible membrane liner (geomembrane),
- 2-foot thick low permeability clay liner, and a

- Soil buffer layer of variable thickness to attain State of Indiana grade requirements (4 percent minimum).

b. Use of institutional controls on landfill property to limit land and ground water use.
c. Installation of an active landfill gas collection system including a vapor phase carbon system to treat the off-gas from the landfill.
d. Monitoring of ground water to ensure effectiveness of the remedial action and to evaluate the need for future ground water treatment.
e. Mitigative measures to be taken during remedial construction activities to minimize adverse impacts to wetlands.

1.5 Record of Decision Modifications

The components of the final landfill cover were modified during the subsequent design by the USACE Omaha District (USACE, 1998) by substituting a geonet for the sand drainage layer, substituting a geosynthetic clay liner for the low permeability clay layer, and including a geotextile as a separation and protective cushion layer above the geonet drainage layer. The final cap design consists of the following components:

- Turf,
- 6-inch thick topsoil layer,
- 18-inch thick select fill layer,
- Geotextile,
- Geonet drainage layer,
- Geomembrane (40-mil),
- Geosynthetic clay liner,
- 12-inch thick foundation layer, and
- Random fill and regraded refuse of variable thickness to attain State of Indiana grade requirements (4 percent minimum).

1.6 Remedial Pre-Design and Design Activities

The primary objective of the Pre-Design Activities was to collect data for the Remedial Design (RD). This included information necessary to develop a long-term ground water and landfill gas monitoring program for the final corrective action, an operations and maintenance plan for the cap and active gas treatment system, and institutional controls for landfill and ground water use. The following elements are described in the *Himco Dump Superfund Site, Final Work Plan For Pre-Design Field Activities*, published in July 1995 (USACE,1995).

a. Field surveys and record searches to review background information on:

- Aerial photography,
- Topographic surveys,
- Horizontal and vertical control,
- Baseline surveys for existing well, trench and soil boring locations,
- Utilities and permits, and
- Boundary surveys and property search.

b. Geological investigations to provide information on landfill limits and material excavatability.
c. Design off-site landfill gas monitoring locations for use after the cap is constructed.
d. Borrow source investigation.
e. Pre-design field investigation. (Referred to as "ground water investigation" in original work plan).
f. Landfill composition.
g. Landfill perimeter inspection for leachate seeps.
h. Foundation soils.
i. Right of entry requirements.

The USACE used the results of the Pre-Design Activities to develop the selected remedial action as specified in the 1993 ROD. In April 1998, USACE submitted to USEPA Region 5, the final RD. The RD contained the following documents: *Himco Dump Superfund Site, Final 100% Design Plans and Specifications, Design Analysis and Operations & Maintenance Plan* (USACE, 1998), for the multi-layered cap and active landfill gas treatment system.

1.7 Summary of Investigations

1.7.1 Pre-Record of Decision Investigations

Five investigations were completed by various agencies prior to USEPA Region 5 publishing the ROD. Investigations were completed during 1974, 1981, 1984, 1990 and 1992.

- **1974 - Indiana State Board of Health Residential Well Sampling.** The Indiana State Board of Health analyzed samples from shallow residential wells located immediately south of the Site after receiving complaints about the color, taste, and odor of ground water from the shallow wells. The analyses indicated the presence of high levels of manganese.

- **1981 - USGS Ground Water Evaluation of Northwest Elkhart County.** The USGS, in cooperation with the Indiana Department of Natural Resources and the Elkhart Water Works, completed a three-year study that determined the extent of a leachate plume potentially emanating from the Site by using bromide concentrations in the ground water as an indicator.

This study is detailed in the *Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana*, published in October 1981 (Imbrigiotta and Martin, 1981).

- **1984 - USEPA Ground Water Evaluation.** The USEPA field investigation team sampled monitoring wells previously installed by the USGS (USEPA, 1985). Laboratory analyses showed that the ground water downgradient of the Site was impacted by metals, SVOC's and VOC's. The metals detected included aluminum, arsenic, barium, chromium, cobalt, selenium, beryllium, cadmium, copper, zinc, manganese, lead, nickel, and mercury. The organic compounds detected included acetone, benzene, phenol, freons, 4-methylphenol, trans 1,2-dichloroethene, 2-butanone, chloroethane, and pyrene. In February 1990, the Site was designated a final NPL site.

- **1990 - USEPA Residential Well Evaluation.** This USEPA evaluation was initiated from the community interviews indicating that residents with private wells south of the Site were complaining about the taste, odor, and color of their water. The USEPA Emergency and Response Branch sampled these wells in late April 1990. The water quality analysis indicated relatively high concentrations of iron, manganese and sodium. After review of the results, the Agency for Toxic Substances and Disease Registry (ATSDR) recommended an alternative source of potable water due to the high levels of sodium. In November 1990, municipal water service was provided to residents.

- **1992 - SEC Donohue Remedial Investigation/Feasibility Study.** A RI/FS was completed by SEC Donohue (Donohue), under contract to the USEPA. The RI field work, which began in 1990 and ended in 1991, included waste characterization, geophysical surveys, test pit excavations, wetlands determination, installation of monitoring wells, and geochemical sampling of soils, sediment, leachate, surface water, ground water, landfill waste mass gas and residential basement gas. The RI concluded that there appears to be no cause for concern for the current uses of the site based on carcinogenic risk estimates less than 1 in 10,000 (1E-04) and Hazard Indices less than 1. Future use of the site that would involve ground water beneath the landfill is a cause for concern since the estimated excess cancer risks are approximately 1E-01 and the Hazard Indices range from 500-1000. Chemicals contributing to these risks include antimony, arsenic, beryllium, cadmium, chromium, vanadium, alpha-chlordane, polynuclear aromatic hydrocarbons, and vinyl chloride. This study is detailed in the Final Remedial Investigation Report (Donohue, 1992).

1.7.2 Post-Record of Decision Investigations

One pre-design investigation and four supplemental site investigations have been conducted at the Site subsequent to the completion of the 1993 ROD. The USACE conducted the pre-design investigation in 1995, and supplemental site investigations were conducted in 1996, 1998, 1999 and 2000. Each investigation was performed to meet a different project objective.

- **1995 - USACE Pre-Design Field Investigation.** The 1995 Pre-Design Field Investigation was performed by the USACE to determine if ground water quality at the Site had changed since the RI sampling was completed in 1991. The elements of this investigation included:

  - Review of the RI/FS and ROD,
  - Visual Site Inspection,
  - Preparation of Field Sampling Plan, Quality Assurance Project Plan, and Site Safety and Health Plan Addendums,
  - Evaluation of 23 existing site monitoring wells and five residential wells,
  - Drilling and sampling of 12 soil borings and the installation of ground water monitoring wells in each boring,
  - Collection of ground water elevation data from 18 existing and 12 newly installed site monitoring wells,
  - Collection of ground water samples from 19 new and existing monitoring wells, and
  - Evaluation of the physical and chemical data.

  Laboratory analyses of the ground water samples showed that ground water was impacted by metals, SVOC's, and VOC's. The metals detected included arsenic, antimony, chromium, lead, manganese, mercury, and thallium. The organics detected included 1,1-dichloroethane, methylene chloride, chloroform, 1,2-dichloroethene, trichloroethene, chlorobenzene, carbon disulfide, benzene, bromodichloromethane, chlorofluoromethane, dichlorofluoromethane, ether, dibenzofuran, fluorene, anthracene, carbazole, naphthalene, acenaphthene, phenanthrene, 2-methylnaphthalene, butylbenzylphthalate, diethylphthalate, and bis(2-ethylhexyl)phthalate. This study is detailed in the *Final Pre-Design Technical Memorandum, Himco Dump Superfund Site*, published in March 1996 (USACE, 1996).

  During the course of the 1995 Pre-Design Field Investigation, construction debris was encountered in borings for monitoring wells WT116A and WT116B. Ground water samples from monitoring well WT116A yielded detects of numerous previously unreported SVOC's, and benzene at 15 micrograms per liter (µg/L), which is above the Maximum Contaminant Level (MCL) of 5 µg/L. These data suggest that portions or all of the CDA may contain higher levels of contamination than previously recognized in the RI/FS. This information from the 1995 Pre-Design Field Investigation produced recommendations for continued ground water monitoring, and the eventual USEPA recommendation to characterize the CDA.

- **1996 - USEPA Supplemental Site Investigation.** The objective of the 1996 Supplemental Site Investigation was to obtain ground water analytical data which could be used to confirm the detections from the 1995 Pre-Design Field Investigation. The 1996 ground water analytical data confirmed the 1995 data; therefore, the USEPA determined that additional remedial and investigative data was needed to support access and deed restrictions to minimize the potential for any future human exposure.

- **1998 - USACE Supplemental Site Investigation.** The 1998 Supplemental Site Investigation was completed by the USACE in order to meet the objectives outlined in detail below. Elements of this supplemental site investigation included:

    - Gathering data on the presence or absence of laterally migrating explosive gases and non-methane VOC's along the southern and eastern edges of the landfill,
    - Collection and analysis of soil samples in the construction debris area including residential properties,
    - Installation of a new ground water monitoring well, and
    - Collection and analysis of ground water samples from six wells for VOC's, SVOC's, and metals.

The baseline risk assessment prepared in 1992 as part of the RI/FS estimated the risk from exposure to ground water, and soils within the landfill proper, but did not address soils in the area immediately south of the landfill limits identified as the CDA. The lack of a baseline human health risk assessment for the CDA soils was identified as a data gap. The USEPA requested that soil sampling be conducted in the CDA, and a supplemental human health risk assessment performed using the analytical results to determine whether risk management activities need to be undertaken regarding the CDA soils. The second objective of the 1998 Supplemental Site Investigation was to obtain ground water analytical data to support a human health risk assessment, which includes estimating risk from exposure to site-wide ground water. The soil and ground water human health risk assessments are presented in Chapters 9 and 10 of this report.

The human health risk assessment for exposure to site ground water and CDA soils was started in 1998; however, subsequent investigations as outlined below have provided additional ground water analytical data. The ground water analytical results from the most current supplemental site investigation conducted in 2000 by various federal agencies was combined with those from the 1998 and 1996 Supplemental Site Investigations, the 1995 USACE Pre-Design Field Investigation (USACE, 1996), and the 1990-1991 Remedial Investigation conducted by SEC Donohue (Donohue, 1992). Collectively, the ground water analytical data were employed in characterizing human health risks potentially posed by (1) ingestion; (2) dermal contact and inhalation during showering/bathing; and (3) inhalation from non-showering household uses of the ground water.

The third objective of the 1998 Supplemental Site Investigation was to obtain soil gas analytical data to assess the occurrence of volatile organic constituents in the soil gas along the southern and eastern perimeter of the landfill. The purpose of the soil gas characterization was to provide USEPA Region 5 with additional risk management information. The soil gas investigations were completed in the fall of 1998 in an area immediately adjacent to and south of the landfill boundary, with some data being obtained along the eastern perimeter of the

landfill. Only the extent of soil gas migration to the south of the landfill was delineated at that time.

- **1999 - USACE Supplemental Site Investigation**. The objective of the 1999 Supplemental Site Investigation was to collect additional soil gas data from an area adjacent to the eastern side of the Site in order to assess the lateral migration of landfill associated gases, to quantify constituent concentrations in soil gas, and to determine whether residences in this area have the potential to be exposed to these constituents in the soil gas.

- **2000 - USEPA, USACE and USGS Supplemental Site Investigation**. The objectives of the 2000 Supplemental Site Investigation were to confirm the presence or absence of constituents that may contribute to the Himco area ground water risk, to determine the degree in which ground water at the Site is currently being affected in both a horizontal and vertical sense by the landfill, and to define any temporal/spatial patterns or trends in the ground water geochemistry related to the landfill.

Specific sampling objectives for the Supplemental Site Investigations are presented in Chapter 2 of this report. All activities for these projects were conducted in accordance with provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Superfund Amendments and Reauthorization Act (SARA) of 1986, and with appropriate requirements of the National Contingency Plan (NCP).

1.8 Report Organization

This report summarizes all available ground water analytical data obtained between 1978 and 1995 for the Site, and discusses the additional site characterization activities that took place in 1996, 1998, 1999 and 2000. Included in these discussions are the different field investigation programs and tasks, laboratory analyses, data reduction, qualitative data evaluation, site characterization, and risk assessment methodology and results.

This report is organized into 12 chapters and 13 appendices. Chapter 1 presents an introduction to the report. Chapter 2 describes the 1996, 1998, 1999 and 2000 Supplemental Site Investigation tasks, including the field activities performed and deviations from the investigative approaches presented in the various work plans. Chapter 3 presents the latest ground water flow data from the 2000 Supplemental Site Investigation, and ground water analytical results from the 1996, 1998 and 2000 Supplemental Site Investigations. Included in Chapter 3 is the analytical data evaluation with summaries of the laboratory quality control and data usability, and the analytical detection summary tables. Chapter 4 summarizes all available ground water analytical data for the Site starting with the first site investigation containing published data, and ending with the 2000 Supplemental Site Investigation. The ground water analytical data are evaluated for use in the risk assessment found in later chapters of this report. Chapters 5 and 6 present the soil gas and CDA soil analytical results, respectively, along with the analytical data evaluations. Chapter 7 presents the contaminant fate and

transport, including a summary of the geology and hydrology, physical/chemical/biological attenuation mechanisms, potential migration pathways, and ground water analytical trend analyses. Chapter 8 presents the overall Site conceptual site model. Chapters 9 and 10 present the human health risk assessment for the CDA and eastern off-site residential areas, respectively. Conclusions and recommendations are found in Chapter 11, and Chapter 12 lists the references used in this report. All tables and figures can be found immediately following the end of the text.

Appendix A contains the 1998 Supplemental Site Investigation soil boring logs. Appendix B contains the 1998 Supplemental Site Investigation monitoring well construction diagram. Appendix C contains the 1998 and 2000 Supplemental Site Investigation monitoring well development records and photos. Appendix D contains the 1996, 1998, and 2000 Supplemental Site Investigation monitoring well sampling records. Appendix E contains the 1998 and 1999 Supplemental Site Investigation soil gas survey forms. Appendix F contains the 2000 Supplemental Site Investigation geophysical logs. Appendix G contains the 2000 Supplemental Site Investigation well gauging forms. Appendix H contains the comprehensive ground water, soil, and soil gas analytical data tables for site investigations conducted between 1984 and 2000. Appendix I contains raw ground water, soil, and soil gas analytical data and validation reports for site investigations conducted between 1996 and 2000. Appendix J contains all site-related monitoring well construction diagrams and geologic logs of borings completed from the Pre-1990 USGS Investigations up through the 1995 Pre-Design Field Investigation. Appendix K contains the intake and risk calculations spreadsheets. Appendix L contains the geostatistical analysis for shallow soil samples in CDA land parcels N, Q, T and R. Appendix M contains toxicological profiles for the main chemicals.

2.0 SUPPLEMENTAL SITE INVESTIGATION TASKS

This chapter presents an overview of the various supplemental site investigation sampling activities conducted at the Site beyond the completion of the 1995 Pre-Design Field Investigation. This includes a 1996 ground water sampling event conducted by the USEPA and USGS, a 1998 soil gas, soil and ground water sampling event conducted by the USACE, a 1999 soil gas sampling event conducted by the USACE, and three separate ground water sampling events conducted in 2000 by the USEPA, USACE and USGS.

Each ground water sampling event listed above involved a unique set of monitoring wells, and sometimes included residential wells. The list of analytes was not consistent between all the supplemental site investigation ground water sampling events. Tables 2-1 and 2-2 provide a summary of all known sampling events involving monitoring wells and residential wells around the Site, respectively, along with the parameters sampled and analyzed for. As indicated in Chapter 1, only those wells used to monitor the ground water contaminant plume emanating from the Site, and the appropriate background wells, are listed in these tables. Construction details for the monitoring wells are summarized in Table 2-3.

2.1 1996 Supplemental Site Investigation Sampling

Ground water samples were collected by personnel from the USEPA and the USGS on November 12 and 13, 1996 to confirm results of the 1995 Pre-Design Field Investigation. Sampling and analysis activities were performed consistent with standard USEPA procedures.

The organic analyses were completed by DataChem Laboratories, Inc., Salt Lake City, Utah. Corresponding inorganic analyses were completed by American Analytical Technical Services, Broken Arrow, Oklahoma.

The location of all monitoring well sampling locations from the 1996 Supplemental Site Investigation can be found in Figure 2-1.

2.1.1 Sampling Objectives

The objective of the 1996 Supplemental Site Investigation was to confirm the ground water analytical detections of the 1995 Pre-Design Field Investigation, primarily benzene found in monitoring well WT116A. In consultation with Indiana Department of Environmental Management, adjacent and downgradient wells were chosen to be sampled. The analytes selected were those detected during the 1995 sampling event.

2.1.2 Ground Water Sampling

Ground water samples were collected from monitoring wells WT105A, WT106A, WT111A, WT115A and WT116A. The samples were analyzed for Target Compound List (TCL) VOC's and SVOC's, and total Target Analyte List (TAL) metals. The ground water analytical results are summarized in Chapter 3.

Prior to purging and sampling a monitoring well, the static water level and well depth were measured with an electronic water level indicator. The monitoring wells were all purged and sampled with a Fultz, positive-displacement, rotor-electric-submersible pump with dedicated Teflon tubing. The pump was lowered approximately three feet below the initial water level, and the pumping commenced. Field water-quality-indicator parameters (temperature, pH, specific conductance, dissolved oxygen and turbidity) were taken with a Hydrolab DataSonde inserted into a flow-through cell. Field water-quality-indicator parameters were recorded during purging, which continued until stabilization of the parameters. The stabilization criteria was established at $\pm$ 10 percent over three successive readings. Following stabilization, the sample bottles were filled and stored in a cooler with ice.

The sampling of monitoring well WT116A was different because of insufficient recharge from the aquifer into the well during purging. As a result, the field water-quality-indicator parameters did not reach stabilization criteria. Subsequently, only VOC samples were collected from the sampling pump tubing, approximately 40 minutes following the cessation of pumping. During purging of the well, the purged water was purple in color.

Monitoring well sampling records containing the purging and sampling information can be found in Appendix D. Purge water was containerized at the individual well sites and later transferred to the landfill where it was disposed of on the ground.

All non-dedicated sampling equipment was thoroughly decontaminated prior to each sampling event to prevent possible cross-contamination. The sampling pump was placed sequentially into three large tubes containing a non-phosphate detergent in potable water, a potable water rinse, and a distilled water rinse. The pump was run using these rinses until approximately 2 gallons of each rinse solution was pumped through the pump and tubing. The outside of the pumps were decontaminated using the same rinse solutions while using a brush.

2.2 1998 Supplemental Site Investigation Sampling

Soil gas, soil and ground water samples were obtained by USACE Omaha District personnel between October 12 and December 14, 1998 for a supplemental site investigation/risk assessment. Sampling and analysis activities were performed in accordance with procedures contained in the Field Sampling Plan (FSP) (USACE, 1998a) and Quality Assurance Project Plan (QAPP) (USACE, 1998b) Addendums. Deviations from the FSP/QAPP Addendums and/or the original documents they amend,

and problems encountered in the field are discussed below.

All soil samples collected between October 12 through October 15, 1998 for organic analyses were submitted to CompuChem Environmental Corporation, Cary, North Carolina. All soil samples collected from these same dates for inorganic analyses were submitted to DataChem Laboratories, Inc., Salt Lake City, Utah. All soil and ground water samples collected after October 15, 1998 for organic analyses were sent to Industrial Environmental Analysts, Inc., Whippany, New Jersey. All soil and ground water samples collected after October 15, 1998 for inorganic analyses were sent to SVL Analytical, Inc., Kellogg, Idaho. All soil gas samples were sent to Air Toxics Ltd., Folsom, California.

The location of all monitoring wells, soil borings and soil gas sampling locations from the 1998 Supplemental Site Investigation can be found in Figures 2-1 through 2-3, respectively.

2.2.1 Sampling Objectives

The major objectives of the 1998 Supplemental Site Investigation were to gather analytical data to support the completion of a supplemental human health risk assessment, and to characterize soil gas constituents. Matrix and site-specific sampling objectives included collecting additional data to:

- Assess the occurrence of organic and inorganic constituents in surface and subsurface soils within the area to the south of the landfill where construction debris was buried and quantify constituent concentrations through laboratory analysis of samples.
- Assess the occurrence of organic and inorganic constituents in ground water immediately south and east of the landfill and quantify constituent concentrations through laboratory analysis of samples.
- Quantitatively assess the risk from soil and ground water to human health resulting from constituents of concern related to a release from the Site.
- Assess the occurrence of organic constituents in the soil gas along the southern and eastern perimeter of the landfill and quantify constituent concentrations through laboratory analysis of samples. This information was to be utilized by USEPA Region 5 for future decision making purposes.

2.2.2 Soil Borings

A total of eighteen soil borings (SB03 through SB20) were drilled and sampled between October 12 and 21, 1998 at various locations in and around the CDA at the Site. Originally, twenty soil borings were proposed. Borings SB01 and SB02 were not completed due to the landowner denying access. The FSP Addendum (USACE, 1998a) called for a minimum of two soil borings on each of the

residential properties bordering or including the CDA. Problems with access to the remaining eighteen proposed locations arose due to heavy vegetation. Therefore, all of the soil borings had to be relocated to some extent, with some property parcels gaining additional soil borings while other property parcels lost one or all of the proposed soil borings. Offsets from the proposed soil boring locations ranged from approximately 25 to 130 feet. Soil samples were obtained from land parcels D, F, M, O, P and S. No soil samples were obtained from land parcels N, Q, R and T. The final soil boring locations are shown on Figure 2-2, along with the property parcels and their respective landowners at the time sampling was completed.

A hand shovel was used to obtain samples for lithologic logging and chemical analyses from 0 to 0.5 feet below ground surface (bgs) in all soil borings except SB16 and SB20. A Gus Pech GP-750 drill rig was then used to complete the remainder of these borings, and was also used along the entire length of soil borings SB16 and SB20. The first soil boring completed (SB03) was drilled using 4-1/4 inch inside diameter hollow-stem augers with a CME continuous sampler. Due to poor recovery and the presence of large amounts of refuse, the remainder of the soil borings were drilled using 3-inch outside diameter stainless-steel split-spoons without augers. The split-spoons were driven by a 140-pound automatic trip hammer.

All drilling/sampling equipment was decontaminated between each borehole while the drill rig was decontaminated once prior to the start of all drilling activities. All decontamination activities for drilling took place on the landfill such that it did not impact the drilling or sampling operations. Decontamination (decon) fluids and sediment were allowed to flow on the ground. Clean drilling/sampling equipment was kept off of the ground by sawhorses, or racks that were located on the rig. Decon was performed using a high pressure/temperature steam cleaner. The water source for all decon and drilling activities was a fire hydrant located at the intersection of County Road 10 and John Weaver Parkway. Drill cuttings from each location were containerized in 55-gallon drums, brought to the landfill, and subsequently spread out on the ground.

All borings were continuously sampled to provide lithologic descriptions along the entire length of each hole. The soil samples were inspected and classified by a geologist using the Unified Soil Classification System (USCS). Logs for all the soil borings are presented in Appendix A. Chemical samples were retained from the 0-0.5 and 0.5-2.0 foot intervals of each boring as specified in the FSP Addendum (USACE, 1998a). The FSP Addendum also called for samples to be retained for chemical analysis from the 2.0-6.0 foot interval of each boring; however, problems with recovery and refusal caused the bottom of this interval to vary. Soil samples were not retained for chemical testing below 2.0 feet in soil borings SB03, SB05, SB06, SB07, SB08, SB09 and SB17. The bottom of this last interval ranged from 3.0 to 6.0 feet in the remainder of the soil borings. Chemical samples were analyzed for TCL VOC's and SVOC's, TAL metals and cyanide. The soil analytical results are discussed in Chapter 6.

2.2.3 Monitoring Well Installation

A single ground water monitoring well (WT119A) was completed in the shallow portion of the aquifer (screened across the water table) downgradient of the WT116 well cluster and outside the CDA (Figure 2-1). The new monitoring well was installed to provide additional analytical data downgradient of monitoring well WT116A, where previous investigations have shown ground water to contain benzene at 15 micrograms per liter (ug/L) (USACE, 1996), which is greater than USEPA regulatory limits.

All drilling/installation activities for the new monitoring well were performed using a Gus Pech GP-750 drill rig and 4-1/4 inch inside diameter hollow-stem augers. The boring was continuously sampled using both 2-inch and 3-inch outside diameter stainless-steel split-spoons for lithologic logging purposes only. The log for the WT119A boring can be found in Appendix A. No soil samples were retained for chemical analyses. Decontamination of the drilling/sampling equipment and the handling of drill cuttings is described in Section 2.2.2 of this report.

Monitoring well WT119A was installed to a depth of 17.85 feet bgs, with the well screen placed across the water table (Table 2-3). The well construction diagram can be found in Appendix B.

The well casing and screen are constructed of threaded, flush-joint, 2-inch nominal diameter Schedule 40 Polyvinyl Chloride (PVC). A 0.35-foot long cap was placed at the base of the screen. The well screen is continuous-wrap design with 0.020-inch slot size, and is 10 feet in length. No adhesives or solvents were used to join sections of well casing or screen.

A filter pack consisting of Georgia Silica 16-35 sand was poured down the annular space between the well screen and augers. The filter pack extends from 0.15 feet below the bottom of the well cap to 1.4 feet above the top of the well screen. A 2.1-feet thick seal of 3/8-inch diameter bentonite pellets was subsequently placed directly above the filter pack by pouring the pellets down the annular space between the well riser and augers. The bentonite pellets were hydrated overnight using potable water obtained from the source mentioned in Section 2.2.2 of this report, then well development activities were commenced the next day. A cement-bentonite grout mixture was eventually poured into the remaining annular space during the surface completion activities described below and after well development was completed. The proportions of this grout mixture are one 94-pound bag of Portland Cement Type I, 6 to 7 gallons of water, and 3 pounds of bentonite powder.

Surface completion for the new monitoring well deviated from that prescribed in the FSP Addendum (USACE, 1998a) in that an above ground construction was substituted for the flush mount design. The protective pad consists of the same grout mixture used to fill the annular space above the bentonite seal, and was placed concurrently with the annular seal. The protective pad was formed by mounding the grout approximately 3 to 4 inches above the ground surface. A 4-inch square by 5-feet long protective steel casing was placed over the well riser and into the protective pad/annular seal material. Two 2-inch diameter steel protective posts were placed outside the protective pad facing

County Road 10, and grouted in. The well riser was cut off approximately 2.5 feet above ground surface and a water tight expandable cap was installed.

2.2.4 Monitoring Well Development

Newly installed monitoring well WT119A and existing well WT116A were developed as described below. All development water was containerized at the individual well sites and later transferred to the landfill where it was spread out on the ground.

Prior to development, the depth to water and total depth of each well were determined with an electronic water level indicator. This data was used to calculate the quantity of water in the casing. All monitoring wells were developed by mechanical surging and pumping using a 2-inch nominal diameter QED Well Wizard positive displacement pump. Surge rings were attached to the pump during the development of WT119A. Surging was accomplished by raising and lowering the pump within the screened interval. Surging continued until the amount of filter pack and formation material being brought into the well decreased markedly. The amount of surging varied from 60 minutes in WT116A to 90 minutes in WT119A. Following the completion of surging, each well was continuously pumped. Field water-quality-indicator parameters temperature, pH, specific conductance and turbidity were periodically monitored during the continuous pumping. Temperature, pH, and specific conductance were measured using an Orion 250A water quality meter. Turbidity was measured using an Engineering Systems 800 turbidity meter. Water-quality-indicator readings, along with the amount of water removed from the well, were recorded on well development records. Well development records can be found in Appendix C. Well development was considered complete when the temperature, pH, and specific conductance had stabilized, and the water was relatively clear and free of fines. The temperature and specific conductance were considered stabilized when there was less than a 10% change between four consecutive readings. The pH was considered stabilized when there was a difference of no more than 0.2 pH units between four consecutive readings.

The final water withdrawn from each well during development was collected in a 1 liter clear glass jar, labeled, and immediately photographed with a 35 millimeter color camera. Photographs of the final development waters can also be found in Appendix C of this document.

2.2.5 Ground Water Sampling

Ground water samples were collected from monitoring wells WT101A, WT102A, WT112A, WT114A, WT115A, WT116A and WT119A between October 19th and 22nd, 1998. The location of these monitoring wells can be found in Figure 2-1. Monitoring wells WT116A and WT119A were allowed to stabilize for 7 days after development activities were completed prior to sampling. All ground water samples were analyzed for TCL VOC's and SVOC's, and total TAL metals plus cyanide. The ground water analytical results are summarized in Chapter 3. The following procedures were used in the collection of ground water samples.

Prior to purging and sampling a well, the static water level and well depth were measured with an electronic water level indicator. This data was used to calculate the quantity of water in the casing. A Grundfos Redi-Flo 2 submersible pump with dedicated Teflon-lined polyethylene tubing was then lowered down the well such that the pump intake was located near the bottom of the screened interval, and pumping was commenced. Average purge rates and volumes ranged from 0.18 to 0.29 gallons per minute (gpm) and 5 to 15 gallons, respectively. Field water-quality-indicator parameters temperature, pH, specific conductance and oxidation/reduction potential (ORP) were measured with the use of a YSI 600XL sonde inserted into a flow-through cell. Turbidity was measured using an Engineered Systems Model 800 turbidity meter. All field water-quality-indicator parameters were measured approximately every well volume evacuated. Dissolved oxygen readings were not obtained due to a bad probe. Purging continued until the parameters temperature, pH, specific conductance and ORP had stabilized (0.2 pH units and a 10 percent change for the other three parameters over four consecutive readings), then ground water samples were obtained. Monitoring well sampling records containing this information can be found in Appendix D. Purge water from the wells was containerized at the individual well sites and later transferred to the landfill where it was spread out on the ground.

All non-dedicated sampling equipment was thoroughly decontaminated prior to each sampling event to prevent possible cross-contamination. The sampling pump was disassembled and the individual parts decontaminated separately. The general decontamination process consisted of a non-phosphate detergent wash using a brush, a potable water rinse, followed by a distilled water rinse. Two equipment rinse blanks were collected on separate days just before sampling the well designated by the blank. The blanks were collected by pumping distilled water through the decontaminated pump and capturing the pump effluent.

No volatile or semivolatile organic compounds were detected in either blank with the exception of bis (2-ethylhexyl)phthalate (BEHP) in one sample. BEHP was not detected in the accompanying field sample. Both of the blanks also contained inorganic analytes at low concentrations as described below. The equipment blank collected prior to sampling well WT115A contained cyanide at 12.0 µg/L J as compared to 12.4 µg/L J in the ground water sample from this location. Zinc was also detected in the blank at 11.2 µg/L J which is greater than the 3.7 µg/L J reported in ground water sample. The zinc and cyanide results from this location have been flagged "UB". Antimony, calcium, iron, selenium, sodium, and zinc were reported in the equipment blank collected prior to sampling well WT119A. Except for antimony concentration of 45.4 µg/L J in the blank, the impact to the sample data is negligible due to the low levels reported in the field sample.

2.2.6 Soil Gas Sampling

Soil gas samples were collected from 24 locations (TT-11 through TT-34) between November 9th and 17th, 1998. A review of the analytical data from this sampling event revealed that vinyl chloride was present in numerous secondary sampling locations; therefore, an additional 19 locations (TT-35 through TT-53) were sampled between December 9th and December 14th, 1998. All soil gas

sampling locations can be found in Figure 2-3. Soil gas samples were analyzed for VOC's and Tentatively Identified Compounds (TIC's). The soil gas analytical results are discussed in Chapter 5. The following procedures were used in the collection of soil gas samples. All pertinent information recorded during the soil gas sampling effort can be found on the Soil Gas Survey Forms located in Appendix E.

At each soil gas sampling location, 5/8-inch outside diameter by 1/4-inch inside diameter nickel plated hardened steel shafts were driven to depths ranging from 3.5 to 5 feet below ground surface. The shafts were then retracted approximately 6 inches in order to separate the shaft sections from an aluminum expendable drive point, which was left in the ground. After exposing the tip of the shaft sections to the subsurface soil, two field screening instruments were concurrently connected to the shafts using a short (1 to 2 foot length) section of 1/4-inch inside diameter silicone tubing and a T-connection.

Field screening instruments included either a Foxboro TVA 1000 photoionization detector (PID)/flame ionization detector (FID) or Hnu PI 101 PID to measure non-methane volatile organic compounds, and an Industrial Scientific TMX 410 combustible gas indicator (CGI) to measure the concentration of hydrogen sulfide and the percent methane. A 10.2 electron volt (eV) lamp was used in both of the PID instruments. The air within the shaft sections and tubing were evacuated using the pumps on the PID/FID or PID, and CGI instruments. Measurements were recorded after the direct reading instruments had stabilized. Field screening results can be found in tabulated form at the end of Appendix E. The combination PID/FID instrument was used during the first round of sampling only, and was replaced during the second round by the PID instrument due to the fact that the subsurface oxygen content was low enough in many of the sampling locations to extinguish the flame on the FID. An extremely high concentration of hydrogen sulfide (>999 parts per million (ppm)) was encountered at soil gas sampling location TT-19 which saturated the sensors on the CGI and caused an overall malfunction of the instrument. A second CGI was temporarily used for field screening purposes; however, this instrument had a malfunctioning lower explosive limit (LEL) sensor. Therefore, methane readings were not obtained from soil gas sampling locations TT-11 through TT-15, TT-17, and TT-26. After rendering the first CGI inoperable, it was decided that the second CGI would not be used if a strong hydrogen sulfide odor was detected. Methane and hydrogen sulfide readings were not obtained from sampling location TT-18. The screening procedure was further modified after soil gas sampling location TT-18 such that the CGI was immediately disconnected if the concentration of hydrogen sulfide was greater than the limits of the sensor. This enabled readings of both methane and hydrogen sulfide to be made without subsequently disabling the instrument for a considerable amount of time.

Upon completion of the field screening, a tenax and tenax/charcoal sorbent tube pair were connected in tandem to the shaft sections using a dedicated piece of 1/4-inch inside diameter Teflon-lined polyethylene tubing. Stainless steel compression fittings were used to connect the Teflon-lined polyethylene tubing to the tenax tube and the tenax-tenax/charcoal pair to each other. A Buck M-5 calibrator followed by a sampling pump were then connected on-line beyond the sampling tubes. The

sampling pump specified in the FSP Addendum (USACE, 1998a) was an MSA Escort ELF; however, problems with this pump occasionally necessitated substituting equipment. Both the pump on the PID/FID and CGI instruments were occasionally used to purge air through the sampling tubes in addition to the MSA pump, and this information has been noted on the Soil Gas Survey Forms (Appendix E). The make of the sampling pump is not critical as the calibrator was always hooked up during the sampling effort to provide real-time flow measurements, and the sampling time could be adjusted to pump a pre-determined amount of air through the sampling tubes.

Following the hookup of all sampling equipment online, the pump was turned on and seven flow rate readings were obtained using the calibrator. The arithmetic mean of the seven readings was used as the flow rate. Flow rates ranged from 0.26 to 1.87 liters/minute. A discussion on sample volumes follows below. At the end of the pre-determined purge time, the pump was turned off, the sample tubes removed from the sampling train and placed back in their culture tubes, and stored on ice at 4 degrees Celsius (° C) until shipment.

All steel shafts and fittings were decontaminated between sampling locations using a non-phosphate detergent wash, a potable water rinse, followed by a distilled water. Two equipment blanks and two ambient air blanks were collected to evaluate the potential influence on the subsurface sample results from sampling equipment. One equipment/ambient air blank pair was collected at the beginning of the field event and the second pair was collected towards the end of sample collection activities. The blanks were labeled to correspond to the sample location collected immediately after the blank collection. The ambient air blanks were collected by drawing ambient air from approximately three feet above the ground surface through a clean sorbent tube at approximately the same flow rate as the field sample collection. The air did not have contact with any sampling equipment as it was drawn into the sorbent tube. The equipment blanks were collected after the ambient air blanks by drawing ambient air through a complete sample collection assembly.

Benzene, toluene, ethyl benzene, xylenes (BTEX), styrene, and carbon tetrachloride were present in both ambient air blanks at comparable concentrations. BTEX, styrene and carbon tetrachloride were also reported in both equipment blanks. Their presence in the equipment blanks is probably due to the presence of these compounds in the ambient air rather than on the equipment. The presence of ethyl benzene and m,p-xylene in soil gas sample TT-12, as site related, cannot be confirmed due to the presence of these compounds in the blanks. The common laboratory contaminants; methylene chloride, acetone, and carbon disulfide were reported in the ambient air blanks and the equipment blanks but not the soil gas samples collected immediately after the blank samples. Tetrachloroethene (PCE) was reported in both equipment blanks and the ambient air blank from location TT-12. PCE was not detected in the sample collected from location TT-12 but was detected at high concentrations in the sample from TT-27. The low levels of PCE reported in the equipment blank does not account for the high concentrations detected in the soil gas sample. Vinyl chloride was detected in one equipment blank. Despite thorough decontamination it may be possible that the steel shaft retained some vinyl chloride that was purged during the equipment blank collection from a previous sample that contained elevated concentrations (>70 $\mu g/m^3$). The field sample that was collected with the same equipment

immediately after the blank was non-detect for vinyl chloride as were the ambient air blank and the trip blank. See Appendix I for a tabular summary of the compounds detected in the blanks.

Sampling rate verification was performed at the beginning of the soil gas sampling effort at location TT-20. The FSP Addendum (USACE, 1998a) called for sampling rate verification at two locations; however, numerous probe refusals at the specified second location (TT-16), compounded by time constraints, permitted sampling rate verification at the above mentioned location only. A sampling rate of approximately 1.47 liters/minute and sampling times of 10, 21 and 30 minutes were employed to purge 14.7, 30.87 and 44.1 liters, respectively through the sampling tubes. Upon review of the analytical data from TT-20, a volume of approximately 40 liters was considered appropriate, and was used at sampling locations TT-22 through TT-25. At location TT-21, a black condensate formed within the Teflon-lined polyethylene and the tenax tube, requiring the pump to be shut down after purging approximately 32 liters of air through the sampling tubes. After consultation with laboratory personnel from Air Toxics Ltd., it was decided to decrease the target air volume to approximately 20 liters.

2.2.7 Surveying

A survey of the soil borings, the newly installed monitoring well and the first round (November 1998) of soil gas sampling locations was completed in November 1998 by USACE. Survey data for soil boring SB05 was inadvertently not obtained. In addition, soil gas sampling locations TT-16 and TT-34 were not surveyed as their final locations had yet to be determined at the time surveying was completed. A listing of the survey data can be found in Table 2-4. The second round (December 1998) of soil gas sampling locations were determined using a measuring tape and compass. Distances and compass directions were measured from existing surveyed monuments such as monitoring wells, etc.

2.3 1999 Supplemental Site Investigation Sampling

Soil gas samples were obtained by USACE personnel between October 20 and 29, 1999 for a Phase 2 Soil Gas Investigation. Sampling and analysis activities were performed in accordance with procedures contained in the FSP (USACE, 1999a) and QAPP (USACE, 1999b) Addendums. Deviations from the FSP/QAPP Addendums and/or the original documents they amend, and problems encountered in the field are discussed below. All soil gas samples collected in October 1999 were sent to Air Toxics Ltd., Folsom, California. The location of all soil gas sampling locations from this 1999 Supplemental Site Investigation can be found in Figure 2-4.

2.3.1 Sampling Objectives

The major objective of the 1999 Supplemental Site Investigation was to collect additional soil gas data from an area adjacent to the eastern side of the Site in order to quantify the lateral migration of landfill associated gases and to determine whether residences in this area have the potential to be

exposed to these gases.

2.3.2 Soil Gas Sampling

Soil gas samples were collected from 45 locations (TT-54 through -87, -89 through -92, -95 through -98 and -100 through -102) and analyzed for VOC's and TIC's. The soil gas analytical results are discussed in Chapter 5. The following procedures were used in the collection of soil gas samples. All pertinent information recorded during the soil gas sampling effort can be found on the Soil Gas Survey Forms located in Appendix E.

At each soil gas sampling location, 5/8-inch outside diameter by 1/4-inch inside diameter nickel-plated hardened steel shafts were driven to a depth of 5 feet bgs, except at TT-73. At this sampling location, the steel shafts were driven to a depth of 3.5 feet bgs after water was originally encountered at 5 feet bgs. The shafts were then retracted approximately 6 inches in order to separate the shaft sections from an aluminum expendable drive point, which was left in the ground. After exposing the tip of the shaft sections to the subsurface soil, an Industrial Scientific TMX 410 CGI was connected to the shafts using a short (1 to 2 foot length) section of 1/4-inch inside diameter silicone tubing to measure the concentration of hydrogen sulfide, and the percent methane and oxygen. Data from the CGI was intended for field screening purposes only. This data was used to determine whether the shafts had been properly seated, and also whether a pre-determined volume of air to be purged through the tenax sorbent tubes (20 liters) should be modified. The air within the shaft sections and tubing were evacuated using a sampling pump attachment to the CGI. Hydrogen sulfide, methane and oxygen measurements were recorded after the readings had stabilized at their highest (hydrogen sulfide and methane) or lowest (oxygen) level. Field screening results can be found in tabulated form at the end of Appendix E. A faulty switch on the CGI prevented calibration of the instrument for slightly over one day, which may have affected readings at the following locations: TT-69, -73, and -80 through -85.

Upon completion of the field screening, a tenax and tenax/charcoal sorbent tube pair were connected in tandem to the shaft sections using a new piece of 1/4-inch inside diameter Teflon-lined polyethylene tubing. Stainless steel compression fittings and Teflon ferrules were used to connect the Teflon-lined polyethylene tubing to the tenax tube and the tenax-tenax/charcoal pair to each other. A Buck M-5 calibrator followed by an Ametek Alpha-1 air sampling pump were then connected on-line beyond the sampling tubes. The sampling tube pair was configured such that purged air flowed through the tenax tube first, followed by the tenax/charcoal tube.

Following the hookup of all sampling equipment online, the pump was turned on and seven flow rate readings were obtained using the calibrator. The arithmetic mean of the seven readings was used as the flow rate. Flow rates ranged from 0.74 to 1.57 liters/minute. The elapsed time required to attain a target volume of 20 liters (10 liters for TT-56 due to high methane and hydrogen sulfide readings) was then calculated by dividing the target volume by the average flow rate. At the end of the pre-determined purge time, the pump was turned off, the sample tubes removed from the sampling train

and placed back in their culture tubes, and stored on ice at 4° C until shipment.

All steel shafts and fittings were decontaminated between sampling locations using a non-phosphate detergent wash, a potable water rinse, followed by a distilled water rinse. Two equipment blanks and two ambient air blanks were collected to evaluate the potential influence on the subsurface sample results from sampling equipment. One equipment/ambient air blank pair was collected at the beginning of the field event and the second pair was collected near the conclusion of sample collection activities. The blanks were labeled to correspond to the sample location collected immediately after the blank collection. The ambient air blanks were collected by drawing ambient air from approximately three feet above the ground surface through a clean sorbent tube at approximately the same flow rate as the field sample collection. The air did not have contact with any sampling equipment as it was drawn into the sorbent tube. The equipment blanks were collected after the ambient air blanks by drawing ambient air through a complete sample collection assembly.

Freon 11 and carbon tetrachloride were present in both ambient air blanks and both equipment blanks at concentrations near the sample reporting limit. These compounds were also reported in the soil gas samples collected immediately after the blank samples. The presence of these compounds as site related subsurface soil gas contamination is suspect based on the blank results. Benzene, toluene, xylenes, styrene, and methylene chloride were present in the ambient air and equipment blanks collected at location TT-96 but not at location TT-71. However, these compounds were not detected in the subsurface soil gas sample collected fromTT-96. Carbon disulfide and acetone were present in both equipment blank samples as well as the corresponding soil gas samples. The absence of these compounds in the ambient air blanks indicates the decontamination process may be a possible source of these compounds in the samples. See Appendix I for a tabular summary of the compounds detected in the blanks.

2.3.3 Surveying

A survey of the 1999 Supplemental Site Investigation soil gas sampling locations was completed in November 1999 by USACE Omaha District. A listing of the survey data can be found in Table 2-4.

2.4 2000 Supplemental Site Investigation Sampling

This section presents the associated tasks from three separate but related ground water sampling events, all of which are part of the supplemental site investigation conducted at the Site. In March 2000, prior to the start of any ground water sampling activities, geophysical logging and well development was conducted on a select number of monitoring wells. Also in March 2000, personnel from the USEPA and USGS obtained ground water samples from residential water wells located east of the site. From mid-April through early-May of 2000, ground water samples were obtained from monitoring and residential wells, and direct-push sampling points. This sampling event was conducted by USEPA, USACE and USGS personnel. In November 2000, the last round of ground water sampling was conducted by USGS personnel. All sampling and analytical activities were

performed in accordance with procedures contained in the FSP (USACE, 2000a) and QAPP (USACE, 2000b) Addendums. Deviations from the FSP/QAPP Addendums and/or the original documents they amend, and problems encountered in the field are discussed below.

All ground water samples collected in March 2000 were submitted to EnviroSystems Inc., Columbia, Maryland for organic analyses, and the USEPA Region 5 Central Regional Laboratory (CRL) for inorganic analyses and selected anions. All ground water samples collected in April/May 2000 were sent to PDP Analytical Services, Woodlands, Texas for organic analyses, and the USEPA Region 5 CRL for inorganic analyses. All ground water samples collected in November 2000 were submitted to the USEPA Region 5 CRL, Chicago, Illinois for organic, inorganic and selected anion analyses, and the U.S. Geological Survey for an emerging contaminants study.

The location of all monitoring wells and direct-push sampling points from the 2000 Supplemental Site Investigation can be found in Figure 2-1. Also found in this figure are the property parcels containing the residential water wells that were sampled.

2.4.1 Sampling Objectives

The major objectives of the 2000 Supplemental Site Investigation were to confirm the presence or absence of constituents that may contribute to the Himco area ground water risk, to determine the degree to which ground water at the Site is currently being affected in both a horizontal and vertical sense by the landfill, and to define any temporal/spatial patterns or trends in the ground water geochemistry related to the landfill.

Matrix and site-specific sampling objectives included collecting additional data to:

- Assess the occurrence of organic and inorganic constituents in ground water east and southeast of the landfill using residential water supply wells, and quantify constituent concentrations through laboratory analysis of samples.
- Assess the occurrence of organic and inorganic constituents in ground water at various levels within the aquifer system using existing monitoring wells surrounding the Site, and quantify constituent concentrations through laboratory analysis of samples.
- Assess the occurrence of organic and inorganic constituents in ground water from multiple depths at selected locations in an attempt to determine potential impacts by the Site to deeper portions of the aquifer system, and quantify constituent concentrations through laboratory analysis of samples.

2.4.2 Geophysical Logging

Monitoring wells WTB1, WTE3, WTG3, WTJ3, WT101C and WT114B were geophysically logged for electromagnetic induction and natural gamma between March 14 and 15, 2000. Copies of the geophysical logs can be found in Appendix F. The natural gamma was used for lithologic correlation. The electromagnetic induction logs were compared to the natural gamma logs to determine if responses in the electromagnetic induction logs may be due to higher specific conductances of the ground water. The average background specific conductances are ranging from 300 to 500 microsiemens per centimeter (µS/cm). High levels of specific conductances have been seen historically (greater than 2,000 µS/cm in monitoring well WTM2) and in more recent data by the USACE (1,960 µS/cm in monitoring well WT114A). This would provide a sufficient contrast such that electromagnetic induction may be able to delineate in the monitoring wells, zones where specific conductivity highs exist. Following the completion of the geophysical logging, identified zones of high specific conductivity were compared to the existing monitoring wells screened intervals to evaluate if the appropriate vertical intervals are present such that the water-quality samples obtained from the monitoring wells will reflect the greatest potential for ground water degradation. In addition, the results were used to guide vertical sampling zones for the direct-push sampling effort in April/May 2000.

2.4.3 Monitoring Well Development

USGS monitoring wells WTB1, WTB3, WTB4, WTE3, WTG1, WTG3 and WTJ1 were redeveloped between March 14 and 16, 2000 as described below. These wells were redeveloped as they had not been sampled since 1991 or earlier. Well development activities were initiated at monitoring well WTJ3, but were not completed for reasons outlined below. Additional monitoring wells were intended to be redeveloped and sampled; however, they could not be located.

Prior to the start of development, the depth to water and total depth of the well were determined using an electronic water level meter. This data was used to calculate the submerged well volume. All monitoring wells were developed with a downhole submersible pump, generally pumping at capacities of approximately 15 to 40 gpm. A Grundfos pump head mounted on a three-phase Franklin pump motor was used. Collapsible PVC hose was connected from the pump head to a pump truck. Piping in the pump truck consisted of galvanized metal. Discharge water from the pump was monitored with a Hydrolab DataSonde inserted into a flow-through cell as the water was pumped through the flow-through cell. The flow-through cell was located in the pump truck within the galvanized plumbing of the pump system, but prior to the PVC discharge hose. The field water-quality-indicator parameters measured were temperature, pH, specific conductance, ORP, dissolved oxygen and turbidity. These parameters were recorded on well development records, which can be found in Appendix C. The Hydrolab DataSonde was calibrated on a daily basis using NIST-traceable calibration solutions and methods recommended by the Hydrolab company. When the field water-quality-indicator parameters had stabilized (+/- approximately 10%) and turbidity was below 5 nephelometric turbidity units (NTU's), the pump was turned off and the water allowed to discharge

back down the well. After approximately 5 minutes had passed, the pump was restarted and field water-quality-indicator parameters were monitored again. This process was repeated several times for each well to insure a surging action was created which would help mobilize fine particles in the well and well screen so they could be removed.

Discharge water from monitoring wells WTG1, WTG3 and WTJ1 was allowed to flow into the City of Elkhart's sanitary sewer system. Water-quality samples, which included VOC's, for the City of Elkhart were obtained prior to the beginning of development at monitoring wells WTG1 and WTG3. These samples were obtained from the end of the hose before discharging into the sanitary sewer. Prior to the disposal of development water from WTJ1, approximately 50 to 60 gallons of water was pumped into a holding tank while the water was screened with a PID and the Hydrolab DataSonde inserted into a flow-through cell. The PID readings were low enough (around 5 ppm) that the development water was pumped directly into the sanitary sewer. The initial development water from monitoring well WTJ3 was also collected in a holding tank for screening prior to disposal. The highest PID reading was approximately 27 ppm; therefore, the development water was not discharged into the sanitary sewer. An insufficient amount of water was collected to obtain field water-quality-indicator parameters. Because of the probability of ground water contamination at WTJ3, the water was placed back down the well and development activities were halted at this well; however, a ground water sample was retained for chemical analyses prior to disposal of the water. Discharge water was allowed to flow onto the ground while developing monitoring wells WTB1, WTB3, WTB4 and WTE3 because of their proximity to the landfill. For monitoring wells WTB1, WTB3 and WTB4, the discharge point was approximately 50 feet away from the wells. The distance between monitoring well WTE3 and the ground discharge point was not noted.

At the conclusion of the development effort for each well, including monitoring well WTJ3, samples were collected and analyzed for some combination of the following parameters in order to document the water quality at the conclusion of development: TCL VOC's, TCL SVOC's, total TAL metals, bromide and sulfate. All monitoring wells also had sulfate analyses completed by the use of a spectrophotometer. Table 2-1 summarizes the monitoring wells that were sampled and the analyses performed.

2.4.4 March 2000 Ground Water Sampling Event

Concurrent with the well development effort described in the previous section, ground water samples were collected from 11 residential wells (RW-12 through RW-22) between March 15 and 16, 2000. Figure 2-1 shows those property parcels containing a residential water well that was sampled. Exact well locations are not shown; however, lot numbers are provided. Ground water samples were analyzed for TCL VOC's and SVOC's, and total TAL metals. Selected residential well samples were also analyzed for bromide and sulfate by a laboratory, and sulfate through the use of a spectrophotometer. Table 2-2 summarizes the residential wells that were sampled and the analyses performed. The ground water analytical results are discussed in Chapter 3.

All sampling activities for the residential wells were conducted from outside spigots that are part of the normal water delivery system for the residence. Each spigot was fully opened and allowed to flow for 10 minutes. At the end of this time, the flow rate was decreased and a sample was immediately obtained. Any water treatment devices located inside the residences were bypassed prior to the start of purging. The total volume of water purged ranged from approximately 7 to 57 gallons.

2.4.5 April/May 2000 Ground Water Sampling Event

A network of monitoring and residential wells, and direct-push ground water sampling points were used to obtain supplemental data on ground water quality beneath and surrounding the Site, including both upgradient and downgradient locations. One round of ground water sampling was performed in April and May of 2000 by USACE Omaha District, along with personnel from the USGS and USEPA, and is detailed below. All ground water samples obtained during the April/May sampling event were analyzed for TCL VOC's and SVOC's, total TAL metals, bromide and sulfate. The ground water analytical results are discussed in Chapter 3.

2.4.5.1 Residential Wells

Ground water samples were collected from 12 residential wells (RW-12 through RW-23) between April 17 and 19, 2000. Figure 2-1 shows those property parcels containing a residential water well that was sampled. Table 2-2 summarizes the residential wells that were sampled and the laboratory analyses performed.

All sampling activities for the residential wells were conducted from outside spigots that are part of the normal water delivery system for the residence. Each spigot was fully opened and allowed to flow for 10 minutes. At the end of this time, the flow rate was decreased and a sample was immediately obtained. Any water treatment devices located inside the residences were bypassed prior to the start of purging. The total volume of water purged ranged from approximately 7 to 57 gallons.

2.4.5.2 Direct-Push

A total of 10 direct-push ground water samples were collected from four locations (GPE, GP101, GP114 and GP16) along the south and southeast edge of the Site on April 25, 2000. Direct-push ground water sampling was completed at the following depths: 30-32, 35-37 and 41-43 feet bgs at GPE (adjacent to the WTE cluster); 35-37 and 58-60 feet bgs at GP101 (adjacent to the WT101 cluster; 14.5-16.5, 35-37 and 55-57 feet bgs at GP114 (adjacent to the WT114 cluster); 37-39 and 55-57 feet bgs at GP16 (approximately 260 feet north of the WT114 cluster). Direct-push sampling locations, and depths at each sampling location are found in Figure 2-1. The horizontal locations for the direct-push sampling were selected to create an arc of sampling points around the southeast corner of the landfill, where the residential and monitoring wells indicated a possible ground water

contaminant plume. The vertical intervals sampled were selected because the geophysical logging, described in section 2.4.2, showed responses in the electromagnetic logs (provided in Appendix F) which may indicate the presence of higher specific conductances of the ground water.

Direct-push ground water sampling was conducted utilizing a Geoprobe Model 8A hydraulic sampling device. The Geoprobe unit employed ½-inch inside diameter by 1-inch outside diameter hardened steel rods which were pushed into the ground using a hydraulically powered ram assisted by a hammer. Non-disposable well points were attached to the end of the rods. The length of the screened interval on the well point was 2 feet. At each sampling location, a well point was driven to the first (shallowest) sampling interval, the drive head detached, and a new piece of 3/8-inch polyethylene tubing inserted through the rods into the well point. The discharge end of the tubing was connected to a peristaltic pump using a short dedicated piece of silicone tubing. Purging was performed for approximately 1 to 2 minutes to ensure that any impurities in the tubing were flushed out and there was good flow of ground water. Immediately following purging, a sample was obtained directly from the discharge end of the tubing. Following completion of sampling at a given interval, the polyethylene tubing was withdrawn from the rods, the drive head reattached, and the well point driven to the next sampling interval. New polyethylene tubing was used at each sampling interval.

All equipment coming into contact with ground water was cleaned prior to each use. The rods, well points, and water level measuring tape were rinsed first with a dilute mixture of soap (Liquinox) and tap water, then rinsed with clean tap water, and finally rinsed with a copious amount of distilled water.

2.4.5.3 Monitoring Wells

Ground water samples were collected from monitoring wells WTB1, WTB3, WTB4, WTE1, WTE3, WTG1, WTG3, WT101A, WT101B, WT101C, WT102A, WT102B, WT102C, WT105A, WT106A, WT111A, WT112A, WT112B, WT113A, WT113B, WT114A, WT114B, WT115A, WT116A, WT116B, WT117A, WT117B, WT118B, and WT119A between April 26 and May 3, 2000. Monitoring well WTO1 could not be located, therefore, it was not sampled. The location of all monitoring wells can be found in Figure 2-1. The following procedures were used in the collection of ground water samples.

Prior to purging and sampling a well, the static water level was measured with an electronic water level indicator. This data, along with the total well depth obtained during a ground water level survey conducted the previous week, was used to calculate the quantity of water in the casing. All monitoring wells with the exception of WTB1 were purged and sampled using a Grundfos Redi-Flo 2 submersible pump. Monitoring well WTB1 was purged and sampled using a peristaltic pump and polyethylene tubing due to the unusually large depth to the top of the screened interval (approximately 469 feet bgs). The static water level in WTB1 was measured at 7.38 feet from the top of the well riser on the day of sampling, therefore, the peristaltic pump was capable of lifting water out of the well. Analytical data obtained from WTB1 will be used with caution due to the different purging/sampling

method. Disposable Teflon-lined tubing was employed on wells sampled by USACE personnel (WTB4, WTE1, WTE3, WT101A, WT101B, WT101C, WT105A, WT106A, WT114A, WT114B, WT115A, WT116A, WT116B, WT117A, and WT119A) while dedicated PVC hose was employed on wells sampled by USGS personnel (WTB3, WTG1, WTG3, WT102A, WT102B, WT102C, WT111A, WT112A, WT112B, WT113A, WT113B, WT117B, and WT118B).

For all monitoring wells, the pump (end of tubing for WTB1) was lowered down the well such that the pump intake (end of tubing) was located near the mid-point of the open screen interval, and pumping was commenced. Average purge rates and volumes ranged from approximately 0.1 to 1.0 gpm and 5 to 73 gallons, respectively. A flow-through cell was used to collect field water-quality-indicator parameter readings at all monitoring wells with the exception of WTB1. Due to the different purging/sampling method used to obtain a ground water sample from this well, and the introduction of some uncertainty into the analytical results, field water-quality-indicator parameters to indicate stabilization and sample representivity were not obtained. For monitoring well WTB1, approximately 4 submerged tubing volumes of water were purged prior to sampling.

Field water-quality-indicator parameters temperature, pH, specific conductance, ORP and dissolved oxygen were measured using either a QED FC4000 or Hydrolab DataSonde inserted into a flow-through cell. Turbidity was measured using either a LaMotte 2008 turbidity meter or the Hydrolab DataSonde. All instruments were calibrated on a daily basis following procedures outlined by that particular instrument's manufacturer. Field water-quality-indicator parameters were measured approximately every 0.5 to 5 gallons, depending on the purge rate. Questionable dissolved oxygen readings were obtained while purging monitoring well WTE1. No dissolved oxygen readings were obtained while purging monitoring wells WT114A, WT114B, WT116A, and WT116B due to a bad probe. Questionable turbidity readings were obtained while purging monitoring wells WT102C and WT114A. The turbidity meter could not be calibrated to a standard before obtaining readings from WT114A, and the turbidity readings are considered to be artificially elevated. Purging continued until field water-quality-indicator parameters had stabilized, then ground water samples were immediately obtained. Monitoring well sampling records containing this information can be found in Appendix D.

All equipment coming into contact with ground water was cleaned prior to each use. Pumps, PVC hose and connectors, flow-through cells, and water level measuring tapes were rinsed first with a dilute mixture of soap (Liquinox) and tap water, then rinsed with clean tap water, and finally rinsed with a copious amount of distilled water. Two equipment rinse blanks, one near the beginning and one near the end of the sampling event, were collected by pumping distilled water through and pouring over the decontaminated sampling equipment and capturing the run-off. A sample of the distilled water was also collected directly from the source.

No volatile organic compounds were detected in the source blank. Bis (2-ethylhexyl)phthalate (BEHP) was detected in the source blank at a concentration of 33 µg/L. The source blank was free from inorganic contamination with the exception of 3.9 µg/L J of magnesium. No volatile or semivolatile compounds were detected in the equipment blank collected at location WT114A.

However, the equipment blank collected at location WT102C contained acetone, several trihalomethanes (chloroform, bromodichloromethane, dibromochloromethane), and 2- butanone. Because these analytes were not detected in the source blank their presence is likely due to inadequate rinsing of potable water from the sampling equipment. The field sample collected directly after this QC sample is not impacted since these compounds were not detected. Both of the equipment blanks contained inorganic analytes with the higher concentrations noted at location WT102C. Of note is the presence of calcium at 648 µg/L, magnesium at 197 µg/L, and sodium at 4160 µg/L from location WT102C, and 140 µg/L of calcium from location WT114A. All other inorganic analytes were detected concentrations of 69.9 µg/L or less. The impact to the sample data is negligible. See Appendix I for a list of analytes detected.

All water generated from decontamination activities and the sampling of downgradient wells, with the exception of the WTG well cluster (WTG1, WTG3), was containerized and transported to the landfill where it was disposed of on the ground within the landfill limits. Water generated from the sampling of the WTG well cluster was disposed of in the municipal sewer system. Water generated from the sampling of all upgradient wells was disposed of on the ground adjacent to the well.

2.4.6 November 2000 Ground Water Sampling Event

Water-quality samples were collected from two monitoring wells and two residential wells to support the evaluation of "emerging contaminants" at the Site by staff from the USGS. The USGS has developed field and research analytical protocols for contaminants that are not routinely monitored in urban settings, including landfills. These emerging contaminants include antibiotics, human drugs (aspirin, caffeine, acetaminophen, etc.), sex/steroid hormones, and other types of chemicals routinely used and disposed of in an industrial society. Since this landfill has been a disposal point for two pharmaceutical companies, the likelihood of disposal of these emerging contaminants was considered a possibility and evaluated.

2.4.6.1 Residential Wells

Ground water samples were collected from 2 residential wells (RW-22 and RW-24) on November 15, 2000. Figure 2-1 shows those property parcels containing a residential water well that was sampled. Ground water samples were analyzed for TCL VOC's and SVOC's, polychlorinated biphenyls (PCB's), pesticides, total TAL metals plus cyanide, bromide, sulfate, chloride, and one of the two residential well samples was also analyzed for "emerging contaminants". Table 2-2 summarizes the residential wells that were sampled and the analyses performed. The ground water analytical results are discussed in Chapter 3.

Both residential wells were sampled from outside spigots that are part of the normal water delivery system for the residence. Each spigot was fully opened and allowed to flow. For both residential wells sampled, field water-quality-indicator parameters (temperature, pH, specific conductance, dissolved oxygen and turbidity) were measured with a Hydrolab DataSonde inserted into a flow-

through cell. Upon stabilization, at approximately 20 to 25 minutes, the flow rate was decreased and a sample was immediately obtained. The stabilization criteria was established at ± 10 percent over three successive readings. Any water treatment devices located inside the residences were bypassed prior to the start of purging.

2.4.6.2 Monitoring Wells

Ground water samples were collected from monitoring wells WT101A and WT116A on November 16, 2000. The location of these monitoring wells can be found in Figure 2-1. Ground water samples were analyzed for TCL VOC's and SVOC's, PCB's, Pesticides, total TAL metals plus cyanide, bromide, sulfate, chloride, and "emerging contaminants". The ground water analytical results are discussed in Chapter 3.

For the monitoring well sampling, the water level was measured and recorded. A Fultz pump with Teflon tubing was used to purge and sample the monitoring wells. Field water-quality-indicator parameters (temperature, pH, specific conductance, dissolved oxygen and turbidity) were measured with a Hydrolab DataSonde inserted into a flow-through cell. The calibration of the sonde was checked daily and adjustments were made as necessary. Field water-quality-indicator parameters were measured and recorded during purging, which continued until stabilization. The stabilization criteria was established at ± 10 percent over three successive readings. Following stabilization, the sample bottles were filled and stored in a cooler with ice.

Purge and decon water was pumped onto the landfill ground away from the monitoring well. Field notes were recorded into a field notebook, and copies are provided in Appendix D.

All non-dedicated sampling equipment was thoroughly decontaminated prior to each sampling event to prevent possible cross-contamination. The sampling pump was placed sequentially into three large tubes containing a non-phosphate detergent in potable water, a potable water rinse, followed by a distilled water rinse. The pump was run using these rinses until approximately 2 gallons of each rinse solution was pumped through the pump and tubing. The outside of the pump was decontaminated using the same rinse solutions applied using a pump sprayer and scrubbed using a brush. An equipment blank was collected by collecting distilled water from the pump effluent. This blank showed chloride, sulfate, bromide, calcium, copper, iron, potassium, magnesium, sodium, vanadium, nickel, methylene chloride, chloroform, 1,2-dichloroethane, bromodichloromethane, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate contamination. The data has been qualifed "B" where the sample concentrations are greater than five times the amount of detected in the blank or "UB" when the amount detected is less than five times the amount reported in the blank. There were no instances of common laboratory contaminant detection in the samples.

2.4.7 Water Level Measurements

Complete rounds of ground water level measurements were obtained between March 13 and March 15, 2000 and April 19 and 20, 2000 from approximately 30 monitoring wells at the Site. Monitoring wells were grouped according to where they are screened within the aquifer, and include shallow (screened across or within approximately 30 feet below the water table), intermediate (screened approximately 60 to 100 feet bgs), and deep (screened greater than 100 feet bgs) monitoring wells. Water level measurements were taken from the following shallow monitoring wells: WTG1, WTJ1 (March only), WT101A, WT102A (April only), WT103A, WT104A, WT105A, WT106A, WT111A, WT112A, WT113A, WT114A, WT115A, WT116A, WT117A, and WT119A. Shallow monitoring well WTB2 was dry, and WTO1 could not be located. The following intermediate monitoring wells were used in the ground water level survey: WTE1, WT101B, WT102B (April only), WT112B, WT113B, WT114B, WT116B, WT117B, and WT118B. Water level measurements were taken from the following aquifer monitoring wells: WTB1, WTB3, WTB4 (March only), WTE3, WTG3, WTJ3 (March only), WT101C, and WT102C. The protective casing to deep monitoring well WTB4 could not be opened during the April measurements and no water level was obtained from this well. Monitoring well locations can be found in Figure 2-1.

The second site-wide ground water level survey was conducted immediately prior to all the April/May 2000 ground water sampling activities. Ground water level measurements were completed within approximately a 31 hour time period, partly due to heavy rain and thunderstorms. Approximately 2.25 inches of rain fell between the first and second days of the water level survey. Prior to removing the well cap and taking a water level measurement, each well was visually inspected for damage or irregularities. The depth to water and total depth of the well was then determined with an electronic water level indicator. Well gauging forms containing the field information for the April measurements are located in Appendix G. Results of the April water level survey are discussed in Chapter 3.0.

3.0 SUPPLEMENTAL SITE INVESTIGATION GROUND WATER RESULTS

This chapter presents the ground water results from the supplemental site investigations performed for the Site during the period 1996 through 2000. Included is a discussion of the site-specific ground water flow, followed by a characterization of the chemicals found and their distribution across the site. Analytical data results are summarized for ground water samples obtained from residential water wells, monitoring wells and direct-push sampling points. Four specific monitoring well sampling events have occurred: November 1996, October 1998, April/May 2000, and November 2000. Three residential water well sampling events occurred between the months of March and November 2000. The analytical data from all of these sampling events are presented in this chapter. Ground water samples were generally analyzed for TCL VOC's and SVOC's, and total TAL metals. A subset were also analyzed for various combinations of pesticides and PCB's, cyanide, bromide, sulfate and chloride. The analyses were performed using USEPA Contract Laboratory Program Organic Routine Analytical Services/Low Concentration Organic Analytical Services, Inorganic Routine Analytical Services, modified Inorganic Routine Analytical Services, Test Methods for Evaluating Solid Waste, SW-846 Third Addition, or EPA Drinking Standard Methods, 1996. The Low Concentration Analytical Service used for the 2000 sampling and analysis allows for the isolation, detection, and quantitative measurement of a broader list of analytes, at lower concentrations, than previously achieved in the 1996 and 1998 sampling using the Statement of Work at that time.

3.1 Ground Water Flow

Two water level surveys were completed between March and April of 2000 to assist with the interpretation of ground water flow directions at different depths within the aquifer beneath the Site. A brief description of the procedures that were followed for these water level surveys can be found in Section 2.4.7. Ground water levels and elevations for the April 2000 event are summarized in Table 3-1. The water level data were grouped and contoured according to monitoring well screen depths. Data for shallow levels of the aquifer were obtained from monitoring wells screened across or within approximately 30 feet below the water table (shallow monitoring wells). Data for intermediate levels of the aquifer were obtained from monitoring wells screened approximately 60 to 100 feet below ground surface (intermediate monitoring wells), and data for deep levels of the aquifer were obtained from monitoring wells screened greater than 100 feet below ground surface (deep monitoring wells).

The results of contouring the April 2000 shallow monitoring well data are shown in Figure 3-1. Overall, ground water at or near the water table appears to be flowing predominantly to the south-southeast across the Site; however, local variations in the flow direction are apparent. These local flow variations may in part be the result of unequal monitoring well distribution across the Site, which results in more speculation in the interpolation of ground water elevation contours in areas with a lesser density of sampling points. The overall direction of ground water flow is consistent with other published regional and site-specific interpretations of ground water elevation data (Imbrigiotta and Martin, 1981; Duwelius and Silcox, 1991; Donohue, 1992).

Ground water flow in the southern portion of the site where shallow monitoring well density is the greatest is towards the south to southwest. The gradient appears to steepen significantly in the vicinity of the landfill proper near monitoring well WT103A. One possible explanation for this increased gradient is a localized mounding effect from two ponds located immediately adjacent to and north of WT103A. Another possible cause for the ground water gradient to steepen in the vicinity of WT103A is mounding of the water table beneath the landfill. Neither of these scenarios can be verified given the current number and distribution of monitoring wells or the number of monitoring events; however, ground water elevation data obtained during the RI supports the interpretation that the ponds exert some control on the ground water flow. A comparison of ground water levels obtained during the RI from staff gauges installed in all three ponds at the Site and surrounding monitoring wells showed close correlation in water table elevations. This would indicate that the ponds act as a recharge source for the aquifer, but mounding of the water table does not occur as a result of their existence. It is more likely that the increase in the water table gradient seen in Figure 3-1 is related to the existence of material of different hydraulic conductivity (i.e. landfill-related material).

Ground water flow directions and gradients for the central portion of the site are highly speculative as no monitoring wells exist in this region. One possible scenario involves mounding of the water table underneath the landfill as suggested above. In this case, the landfill could exert a significant amount of influence on the ground water gradient, and potentially the flow direction. The red colored contours shown in Figure 3-1 are one interpretation of the ground water flow regime involving ground water mounding and radial flow away from the landfill. The ground water flow direction is shown to vary widely in the central portion of the site from south to east to northeast, depending on the location relative to the landfill boundary. Another data interpretation where there is no mounding effect from the landfill is shown on Figure 3-1 by the blue colored contour lines. In this scenario, the ground water flow direction is shown to flow more consistently in a south to southeast direction.

Ground water flow at or near the water table in the northern part of the site is towards the southeast as shown in Figure 3-1. The interpolated contours are based on a somewhat limited number of data points.

Contoured April 2000 ground water elevation data from the intermediate monitoring wells (Figure 3-2) indicates flow predominantly to the southeast, with a southwest flow component in the southwest corner of the site. In general, the overall flow direction in the intermediate levels of the aquifer is similar to that in the shallow levels. The effects of the mounding due to the landfill and/or the ponds is expected to be dissipated by the intermediate level of the aquifer because of the high hydraulic conductivities. A more detailed discussion on hydraulic conductivities of the aquifer beneath the Site can be found in Chapter 7.

There is an insufficient amount of monitoring wells to contour the April 2000 water elevation data for deep levels of the aquifer.

No clear trends in the direction (up versus down) of vertical ground water flow gradients were noted across the Site. Both upward and downward vertical gradients were observed in well clusters comprised of shallow/intermediate monitoring wells, with a predominance of downward gradients (Table 3-1). These observations are not consistent with the results of the RI, where upward flow gradients were predominant between shallow and intermediate levels of the aquifer. Heavy rains which occurred during the water level survey (see Section 2.4.7) most likely resulted in increased infiltration which biased the number and distribution of downward vertical gradients. It should also be noted that the data base of well clusters has increased considerably from the RI to this field investigation.

Upward vertical gradients were noted in all well clusters comprised of intermediate/deep monitoring wells (Table 3-1). Monitoring wells set at greater depths most likely reflect the regional ground water flow system where ground water discharges to the St. Joseph River and upward vertical flow dominates the system.

3.2 Analytical Data Qualifiers

The data was reviewed in the laboratory and qualifiers were applied as required by the Statement of Work. The data was then validated, by an independent reviewer, which resulted in additional qualifiers, as needed, to support the data usability.

The detected constituents, summarized in the tables accompanying this chapter, reflect the qualifiers added by the laboratory and the data reviewers. The following conventions have been applied and are included in the Chapter 3 tables. Appendix H contains a summary of the analytical results and Appendix I contains the original laboratory reports and validation results that support the qualifiers.

- All data that are estimated, regardless of the concentration reported, have been qualified "J".
- All data that are reported as not detected are qualified "U".
- All data that are reported as non-detect with an estimated quantitation limit have been qualified "UJ".
- The inorganic Statement of Work (SOW) qualifiers "B" and "M", used to represent estimated data, have been changed to "J" for use in the data tables and risk assessment to minimize the qualifiers used and avoid confusion.
- Qualifiers based on blank contamination: All organic and inorganic samples that contain an analyte that is also present in a trip blank, equipment rinse blank or laboratory method blank, are qualified "B" unless the amount present is less than ten times the blank concentration for the common laboratory contaminants or five times the amount present in the blank for all other analytes. If the amount present in the sample is less than ten times the amount present in the

blank for the common laboratory contaminants, or five times the amount present in the blank for any other analyte, the result is qualified "UB".

3.3 1996 Supplemental Site Investigation Analytical Results

3.3.1 Data Limitations

The data met the data quality objectives for precision, accuracy, representativeness, comparability and completeness, and is adequate for its intended use. No data limitations were noted.

3.3.2 Ground Water Analytical Data Results

Five ground water samples and one duplicate sample were collected and analyzed for TCL volatiles and semivolatiles and total TAL metals, with the exception of WT116A which was sampled for VOC's only due to the lack of water in the monitoring well. The ground water analytical detections are summarized in Table 3-2. Appendix H contains a summary of the analytical results and Appendix I contains the original laboratory reports and validation results that support the qualifiers. A summary of the data usability was presented earlier in this section.

Total 1,2-dichloroethene was detected at estimated concentrations of 3 µg/L and 0.4 µg/L in samples from monitoring wells WT106A and WT116A, respectively. The following constituents were also detected at estimated concentrations in the sample from monitoring well WT116A: 1,1-dichloroethane at 5 µg/L, 1,2-dichloropropane at 2 µg/L, trichloroethene at 0.5 µg/L, and benzene at 7 µg/L. The sample from monitoring well WT115A also contained benzene at an estimated concentration of 3 µg/L. All other volatile compounds were reported as less than the reporting limit of 10 µg/L.

Bis(2-ethylhexyl)phthalate was reported at 10 µg/L in the duplicate sample from monitoring well WT111A, but was not detected in the primary sample. No other semivolatile organic compounds were detected in this round of ground water samples, including the polynuclear aromatic hydrocarbons detected in 1995, in a sample from well WT116A.

Except for antimony, beryllium, cadmium, lead, mercury, selenium and silver, all of the TAL metals were detected at least once. Aluminum was detected in samples from WT111A, WT106A and WT115A at concentrations of 280 µg/L (267 µg/L in duplicate), 50.8 µg/L and 32.0 µg/L, respectively. Arsenic was detected in samples from WT111A and WT106A at concentrations of 3.7 µg/L (3.1 µg/L in duplicate) and 5.6 µg/L, respectively. Barium was detected in all the monitoring well samples at concentrations ranging from 5.4 to 107 µg/L. Cobalt was detected in samples from WT111A and WT115A at concentrations of 6.4 µg/L (6.7 µg/L in duplicate) and 1.6 µg/L, respectively. Calcium was detected in all the monitoring well samples at concentrations ranging from 8,160 to 215,000 µg/L. Chromium was detected in samples from WT111A and WT115A at concentrations of 1.8 µg/L (1.5 µg/L in duplicate) and 2.9 µg/L, respectively. Copper was also detected in samples from WT111A and WT115A, but at concentrations of 3.3 µg/L (3.0 µg/L in

duplicate) and 1.8 µg/L, respectively. Iron was detected in all the monitoring well samples at concentrations ranging from 13.1 to 6,080 µg/L. Magnesium was detected in all the monitoring well samples at concentrations ranging from 2,980 to 36,000 µg/L. Manganese was detected in all the monitoring well samples at concentrations ranging from 5 to 394 µg/L. Nickel was detected in all the monitoring well samples except from WT105A at concentrations ranging from 1.8 to 7.2 µg/L. Potassium was detected in all the monitoring well samples at concentrations ranging from 1,600 to 6,520 µg/L. Sodium was detected in all the monitoring well samples at concentrations ranging from 3,200 to 33,600 µg/L. Thallium was detected in all the monitoring well samples except from WT105A at concentrations ranging from 2.2 to 3.0 µg/L. Vanadium was detected in samples from WT111A and WT115A at 2.4 µg/L (2.4 µg/L in duplicate) and 7.6 µg/L, respectively. Zinc was detected in all the monitoring well samples at estimated concentrations ranging from 2.9 to 22.2 µg/L.

3.4 1998 Supplemental Site Investigation Analytical Results

3.4.1 Data Limitations

The ground water samples discussed below have specific limitations and should be used with caution.

- The zinc and cyanide results from sample WT115A should be used with caution as these analytes were also reported in the equipment rinse blank.
- The antimony result of 43.2 µg/L, in the sample from WT119A has been qualified "UB". This concentration is just above the quantitation limit of 42.2 µg/L and less than five times that of the equipment blank concentration of 45.4µg/L.
- Sample results for metals analysis from locations WT102A, WT112A, WT114A and WT116A have been estimated based on sample pH of 3 as measured upon receipt by the laboratory. This indicates a possible lack of preservative as a pH of less than 2 is required.
- Selenium results for samples collected from locations WT101A, WT101A Dup, WT115A, and WT116A are unusable due to extremely low (26%) spike recovery during sample analysis. The results have been qualified "R".

The data met the data quality objectives for precision, accuracy, representativeness, comparability and completeness, and are adequate for their intended use except for sensitivity, and as noted above. The most notable data restriction observed for the ground water data is that the contract required quantitation limits exceed the risk based screening levels for many compounds. Because of this restriction, the presence or absence of these compounds below the screening criteria cannot always be definitively determined.

3.4.2 Ground Water Analytical Data Results

Seven ground water samples and two duplicate samples were collected and analyzed for TCL volatiles and semivolatile and total TAL metals plus cyanide. The ground water analytical results are summarized in Table 3-3. Appendix H contains a summary of the analytical results and Appendix I contains the original laboratory reports and validation results that support the qualifiers. A summary of the data quality usability was presented earlier in this section.

1,1-dichloroethane was the only volatile organic compound detected during this sampling event. Estimated concentrations reported include 4 µg/L in the sample from WT114A, and 5 µg/L in the sample from WT116A. All other volatile organic compounds were reported as less than the reporting limit of 10 µg/L.

Phthalates were the only semivolatile organic compounds detected in this round of ground water samples. Diethylphthalate was detected at concentrations of 19 µg/L (9 µg/L in the duplicate) and 2 µg/L in samples from WT101A and WT114A, respectively. Bis(2-ethylhexyl)phthalate was detected at estimated concentrations of 3 µg/L in the sample from WT102A, and 2 µg/L in the sample from WT116A.

Except for cadmium, thallium and vanadium, all of the TAL metals and cyanide were detected at least once. Aluminum was detected in samples from WT102A, WT115A, WT116A and WT119A at concentrations of 27.6 µg/L, 94.1 µg/L, 58.0 µg/L and 258 µg/L (249 µg/L in the duplicate), respectively. Antimony was detected at 43.2 µg/L in the sample from WT119A, but was not reported in the duplicate sample (<42.2 µg/L) collected from this location. Arsenic was detected in samples from WT101A, WT114A, WT115A, WT116A and WT119A at 3.6 µg/L (3.3 µg/L in the duplicate), 24.3 µg/L, 0.90 µg/L, 1.0 µg/L and 5.8 µg/L (5.3 µg/L in the duplicate), respectively. Barium was detected in samples from all monitoring wells except WT115A at concentrations ranging from 36.6 to 238 µg/L. Beryllium and cobalt were detected once each, in the sample collected from WT114A, at estimated concentrations of 0.60 µg/L and 11.9 µg/L, respectively. Calcium was detected in samples from all monitoring wells at concentrations ranging from 19,000 to 377,000 µg/L. Chromium was detected in samples from all monitoring wells, except WT116A, at concentrations ranging from 7.5 to 20.3 µg/L. Copper and lead were both detected in the sample from WT119A at concentrations of 5.4 µg/L (4.9 µg/L in the duplicate) and 3.4 µg/L (2.4 µg/L in the duplicate), respectively. Iron was detected in samples from all monitoring wells except WT112A at concentrations ranging from 28,100 µg/L (26,900 µg/L in the duplicate) in WT101A, 96.8 µg/L in WT102A, 17,900 µg/L in WT114A, 4,590 µg/L in WT115A, 4,490 µg/L in WT116A and 1,690 µg/L (1,690 µg/L in the duplicate) in WT119A. Magnesium was detected in samples from all monitoring wells at concentrations ranging from 13,900 to 52,700 µg/L. Manganese was detected at 3,080 µg/L (2,940 µg/L in the duplicate) in the sample from WT101A, 61.5 µg/L in the sample from WT102A, 6.7 µg/L in the sample from WT112A, 306 µg/L in the sample from WT114A, 513 µg/L in the sample from WT115A, 662 µg/L in the sample from WT116A, and 279 µg/L (279 µg/L in the duplicate) in the sample from WT119A. Mercury was detected at 0.10 µg/L in samples from both WT102A and

WT116A. No other detections of mercury were reported. Nickel was detected only in the sample from WT102A at a concentration of 73.0 µg/L. Potassium was detected in samples from all monitoring wells at concentrations ranging from 1,330 to 25,200 µg/L. Selenium was reported as non-detect in samples from WT102A, WT112A, WT114A and WT119A. Selenium data was rejected for samples from WT101A, WT115A and WT116A. Silver was detected in the sample from WT102A at a concentration of 6.1 µg/L. Sodium was detected in samples from all monitoring wells at concentrations ranging from 12,100 to 69,100 µg/L except for the sample from WT116A, which was reported at 179,000 µg/L. Zinc was detected in the sample from WT114A at 3.2 µg/L, and the sample from WT115A at 3.7 µg/L. Zinc was reported as non-detect in all other monitoring well samples. Cyanide was detected in all monitoring well samples at concentrations ranging from 7.3 to 31.9 µg/L.

3.5 2000 Supplemental Site Investigation Analytical Results

3.5.1 Data Limitations

March, April and May 2000 Sampling Event - No specific limitations, other than estimation of some data, and addition of B and UB flags due to blank contamination, were noted except for the samples described below. The data from these samples should be used with caution.

- Metals data from monitoring well WT102C should be used with caution as turbidity readings are noted as questionable. Although the turbidity readings are quite low, there is no documentation as to whether the sample was visually clear.

- Metals data from monitoring wells WT106A and WT115A should be used with caution as final turbidity readings were well above 50 NTU's.

- Specific measurements of turbidity were not made for the direct push samples because the sample turbidity prevented light from passing through the 40 milliliter (mL) glass sample vial. The metals results from these samples are of marginal quantitative value because it can not be determined whether the source of the inorganics present in the sample is due to the interference of soil matrix suspended in the water or dissolved metals in the water itself.

- The data from monitoring well WTB1 should be used with caution. The sample collection method used to obtain the ground water sample was quite different compared to the sampling method used for all other monitoring wells. The objective of sampling this well was to verify the presence or absence of volatile organic compounds at considerable depth within the aquifer.

November 2000 Sampling Event - The equipment blank collect during this event showed chloride, sulfate, bromide, calcium, copper, iron, potassium, magnesium, sodium, vanadium, nickel, methylene chloride, chloroform, 1,2-dichloroethane, bromodichloromethane, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate contamination. The data has been qualifed "B" where the sample concentrations

are greater than five times the amount of detected in the blank or "UB" when the amount detected is less than five times the amount reported in the blank. There were no instances of common laboratory contaminant detection in the samples

The data met the data quality objectives for precision, accuracy, representativeness, comparability and completeness, and are adequate for their intended use except as noted above.

3.5.2 Ground Water Analytical Data Results

3.5.2.1 March 2000 Residential Well Sampling

Eleven residential well ground water samples and one duplicate sample were collected and analyzed for TCL volatiles and semivolatile and total TAL metals. Six of the residential well samples were also analyzed by a laboratory for bromide and sulfate. The residential well ground water analytical results are summarized in Table 3-4. Appendix H contains a summary of the analytical results and Appendix I contains the original laboratory reports and validation results that support the qualifiers. A summary of the data quality evaluation and data usability was presented previously in this section.

Vinyl chloride was detected in samples from RW-22 and RW-18 at estimated concentrations of 0.9 µg/L and 0.7 µg/L, respectively. 1,2-dichloropropane was also detected in the sample from RW-22 at a concentration of 10 µg/L. 1,1-dichloroethane was detected in six of the eleven residential well samples at concentrations ranging from an estimated 0.5 to 7 µg/L. Cis-1,2-dichloroethene was detected in five of the eleven residential well samples (five of the same six well samples with detections of 1,1-dichloroethane) at concentrations ranging from an estimated 0.5 to 2 µg/L. Benzene was detected in samples from RW-22 and RW-21, both at estimated concentrations of 0.4 µg/L. 1,2-dichloroethane was detected in samples from RW-22, RW-21, and RW-15 at estimated concentrations of 0.6 µg/L, 0.7 µg/L and 0.6 µg/L, respectively. Chloroform was detected in the sample from RW-20 at an estimated concentration of 0.4 µg/L.

No semivolatile organic compounds were detected in this round of residential well ground water sampling.

Except for aluminum, antimony, beryllium, cadmium, lead, mercury, selenium, silver, thallium and vanadium, all of the TAL metals were detected at least once. Barium, calcium, sodium, potassium and magnesium were detected in all of the residential well samples at concentrations ranging from 28.1 to 128 µg/L; 91,500 to 177,000 µg/L; 13,500 to 126,000 µg/L; 1,150 to 5,270 µg/L; and 16,000 to 26,500 µg/L, respectively. Copper was detected in all of the residential well samples, except for the sample collected from RW-22, at concentrations ranging from 4.1 to 66.1 µg/L. Manganese was detected in all of the residential well samples, except for those collected from RW-13 and RW-14, at concentrations ranging from 59.6 to 1,560 µg/L. Zinc was detected in all of the residential well samples, except for the sample collected from RW-12, at concentrations ranging from 14.2 to 160 µg/L. Cobalt was detected in residential well samples collected from RW-21 and RW-14 at estimated

concentrations of 10.5 µg/L (however the duplicate was non-detect at 10.1 µg/L) and 14 µg/L, respectively. Nickel was detected in one residential well sample, from RW-13, at an estimated concentration of 21.4 µg/L. Chromium was detected in residential well samples collected from RW-12 and RW-18 at estimated concentrations of 3.6 µg/L and 3.5 µg/L, respectively. Arsenic was detected in residential well samples collected from RW-21, RW-15, RW-17, and RW-18 at estimated concentrations ranging from 2 to 8 µg/L. Iron was detected in all of the samples collected from the residential wells, except RW-19 and RW-13, at concentrations ranging from and 885 to 6,120 µg/L, respectively.

Bromide was detected in all of the residential well samples at estimated concentrations ranging from 50 to 70 µg/L. Sulfate was also detected in all of the residential well samples collected at concentrations ranging from 132 to 171 milligrams per liter (mg/L).

3.5.2.2 April 2000 Residential Well Sampling

Twelve residential well ground water samples and one duplicate sample were collected and analyzed for TCL volatiles and semivolatile total TAL metals, bromide and sulfate. The residential well ground water analytical results are summarized in Table 3-5. Appendix H contains a summary of the analytical results. The complete data package, corresponding validation reports, and data quality evaluation are presented in Appendix I.

Methylene chloride was detected in the sample from RW-21 at a concentration of 6 µg/L. 1,1-dichloroethane was detected in six of the twelve residential well samples at concentrations ranging from an estimated 0.8 to 12 µg/L. Cis-1,2-dichloroethene was detected in five of the twelve residential well samples (five of the same six wells with detections of 1,1-dichloroethane) at concentrations ranging from an estimated 0.7 to 2 µg/L. 1,2-dichloropropane was detected at a concentration of 9 µg/L in the sample, and its duplicate, from RW-22.

No semivolatile organic compounds were detected in this round of residential well ground water sampling.

Except for aluminum, antimony, beryllium, cadmium, cobalt, mercury, selenium, silver, thallium and vanadium, all of the TAL metals were detected at least once. Barium, calcium, magnesium, potassium, sodium and zinc were detected in all of the residential well samples at concentrations ranging from 29.1 to 131 µg/L; 83,000 to 205,000 µg/L; 13,600 to 27,600 µg/L; 1,100 to 6,920 µg/L; 15,200 to 116,00 µg/L; and 12 to 173 µg/L, respectively. Note that zinc was also detected in the method blank. Chromium was detected in residential well samples collected from RW-15 and RW-20 at estimated concentrations of 2µg/L and 2.1 µg/L, respectively. Copper was detected in all of the residential well samples, except for RW-12 and RW-17, at concentrations ranging from 7.9 to 62.1 µg/L. Nickel and lead were each detected in one residential well sample. Nickel was detected in the sample collected from RW-12 at a concentration of 9.8 µg/L. Lead was detected in the sample collected from RW-22 at an estimated concentration of 2 µg/L but was not detected in the duplicate. Arsenic was detected

in residential well samples collected from RW-21, RW-13, RW-15, RW-12, RW-17 and RW-18, at concentrations ranging from 2 to 8 µg/L. Iron was detected in all of the residential well samples collected, except the sample from RW-23, at concentrations ranging from an estimated 19.6 µg/L to 5870 µg/L.

Bromide was detected in all of the residential well samples at estimated concentrations ranging from 60 to 70 µg/L. Sulfate was also detected in all of the residential well samples, except RW-12, at concentrations ranging from 105 to 153 mg/L

3.5.2.3 November 2000 Residential Well Sampling

Two residential well ground water samples and one duplicate sample were collected and analyzed for TCL volatiles and semivolatile, PCB's, pesticides, total TAL metals plus cyanide, bromide, sulfate and chloride. The ground water analytical results are summarized in Table 3-6. Appendix H contains a summary of the analytical results. The complete data package, corresponding validation reports, and data quality evaluation are presented in Appendix I.

Ethyl ether at 26 µg/L (31 µg/L in the duplicate), dichlorofluoromethane at 5 µg/L (6 µg/L in the duplicate), 1,1-dichloroethane at 4 µg/L (4 µg/L in the duplicate), cis-1,2-dichloroethene at 2 µg/L (3 µg/L in the duplicate), 1,2-dichloroethane at 1 µg/L (1 µg/L in the duplicate) and 1,2-dichloropropane at 8 µg/L (8 µg/L in the duplicate) were detected in the sample collected from RW-22 .

The semivolatile bis(2-ethylhexyl)phthalate was detected in both the sample and the duplicate collected from RW-22 at a concentration of 3 µg/L.

No pesticides or PCB's were detected in this round of residential well ground water sampling.

Except for antimony, arsenic, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, thallium, and vanadium, all of the TAL metals were detected at least once. Cyanide was not detected in any of the samples. Aluminum, barium, calcium, copper, iron, magnesium, manganese, potassium, sodium and zinc were detected in both of the residential well samples at concentrations of 35.9 µg/L and 58.2 µg/L; 48.1 µg/L and 46.9 µg/L; 102,000 µg/L and 129,00 µg/L; 2.3 µg/L and 1 µg/L; 60.2 µg/L and 1,840 µg/L; 24,800 µg/L and 14,200 µg/L; 103 µg/L and 1,250 µg/L; 2,790 µg/L and 4,400 µg/L; 53,100 µg/L and 4,230 µg/L; and 21.7 µg/L and 14.3 µg/L, respectively. Cobalt was detected in the residential well sample from RW-22 at an estimated concentration of 0.8 µg/L.

Sulfate and chloride were detected in both of the residential well samples collected. The sample collected from RW-22, and the duplicate of this sample, were reported at concentrations of 105 mg/L (104 mg/L in the duplicate) and 99.9 mg/L (98.4 mg/L in the duplicate), respectively. The sample collected from RW-24 was reported with concentrations of 79.3 mg/L of sulfate and 96.5 mg/L of chloride. Bromide was detected in the residential sample collected from RW-24 and from the

duplicate sample collected from RW-22 at estimated concentrations of 40 µg/L and 30 µg/L. However, the primary sample collected from RW-22 was reported as non-detect at 14 µg/L.

3.5.2.4 Monitoring Well Sampling

Two rounds of ground water sampling were conducted in 2000. Initially, twenty-nine ground water samples, three duplicate samples, and one split sample (analyzed by a second laboratory) were collected in April/May 2000, and analyzed for TCL volatiles and semivolatiles, total TAL metals, bromide and sulfate. The detections are summarized in Table 3-7. A second round of ground water sampling was conducted in November 2000. In the second sampling event, two ground water samples were collected and analyzed for TCL volatiles and semivolatile, PCB's, pesticides, total TAL metals plus cyanide, bromide, sulfate and chloride. The November 2000 ground water analytical results are summarized in Table 3-6. A summary of the data quality evaluation and data usability was presented previously in this chapter. Appendix H contains a summary of the analytical results. The complete data package, corresponding validation reports, and data quality evaluation are presented in Appendix I.

The following discussion refers to the ground water analytical results obtained from the April/May 2000 sampling event. Vinyl chloride was detected in the sample collected from WT116A and the duplicate from this location at a concentration of 1 µg/L. 1,2-dichloropropane was also detected in the sample and the duplicate collected from WT116A at a concentration of 1 µg/L. These two compounds were not detected in the other monitoring well samples collected during the April/May 2000 sampling event. Chloroethane was detected in samples from WT106A, WT101B, and the WT101A duplicate at concentrations of 0.6 µg/L, 2 µg/L and 2 µg/L, respectively. 1,1-dichloroethane was detected in seven of the twenty-nine monitoring well samples (WT101A, WT116A, WT106A, WT111A, WT114A, WT118A, and WT119A) at concentrations ranging from an estimated 0.9 to 8 µg/L. The split sample collected from well WT114A reported 2.6 µg/L of 1,1dichloroethane as compared to 3 µg/L reported in the primary sample. Cis-1,2-dichloroethene was detected in samples from wells WT115A, WT116A (and the duplicate) and WT106A at concentrations ranging from an estimated 0.5 to 1 µg/L. Benzene was detected in samples from WT101A and WT115A at concentrations of 2 µg/L (in the primary and duplicate sample) and 1 µg/L, respectively and was also detected in the split sample collected from WT114A at an estimated concentration of 0.9 µg/L. Tetrachloroethene and trichloroethene were detected in the sample from WT115A at estimated concentrations of 0.8 µg/L and 0.6 µg/L, respectively. Trichloroethene was also detected in the sample from WT106A at an estimated concentration of 0.6 µg/L. The trihalomethanes (typical byproducts of water supply sterilization) chloroform at 3 µg/L, bromodichloromethane at 2 µg/L, dibromochloromethane at 2 µg/L, and bromoform at 1 µg/L were the only compounds detected in the sample from WTE3. No other volatile compounds were detected.

Phthalates were the only semivolatile organic compounds detected in the April/May 2000 round of ground water monitoring well sampling. Diethylphthalate was detected at concentrations ranging from 1 to 4 µg/L in eight of twenty-nine samples. Bis(2-ethylhexyl)phthalate was detected at concentrations

ranging from 1 to 47 µg/L in eighteen of twenty-nine samples. Butylbenzylphthalate and di-n-octylphthalate were each detected at an estimated concentration of 4 µg/L in the sample from WTE1.

Except for antimony, beryllium and thallium, all of the TAL metals were detected at least once. Barium, calcium, magnesium, manganese, potassium and sodium were detected in all of the monitoring well samples at concentrations ranging from 8.1 to 256 µg/L; 47,900 to 685,000 µg/L; 12,000 to 70,800 µg/L; 0.7 to 1,818 µg/L; 759 to 22,200 µg/L; and 4,600 to 161,000 µg/L, respectively. Selenium was detected in the sample from WTG3 at a concentration of 4 µg/L. Silver was detected in the sample from WT102B at a concentration of 3.4 µg/L. Mercury was detected in the split sample from WT114A at a concentration of 0.011 µg/L. Zinc was detected in the sample from WT116A, and the duplicate of this well, at concentrations of 178 µg/L and 194 µg/L, respectively. Vanadium was detected in samples from WT115A, WT117A, WT102B, WT102C and WT112A at concentrations ranging from 1.9 to 14.5 µg/L. Aluminum was detected in samples collected from WTG3, WT101C, WT102C, WT105A, WT106A, WT111A, WT114A split sample, WT115A, WT117A, and WT119A at concentrations ranging from 36.7 to 8,860 µg/L. Arsenic was detected in samples collected from WTB3, WTE3, WTG3, WT101A, WT101C, WT102B, WT102C, WT106A, WT112B, WT113B, and WT114A at concentrations ranging from 3 to 46 µg/L. Cadmium was detected in samples collected from wells WT106A, WT111A, WT113A, WT115A, and WT116A at concentrations ranging from 0.1 to 0.2 µg/L. Nickel was detected in samples collected from WTB1, WTG1, WTG3, WT101C, WT102A, WT102B, WT102C, WT105A, WT106A, WT111A, WT114A split sample, WT115A, WT116A, and WT117B at concentrations ranging from 4.8 to 73.3 µg/L.

Bromide was detected in all of the monitoring well samples, except WT113A, at estimated concentrations ranging from 40 to 80 µg/L in WT114B, WT117A, WT117B, WT102B, WT112A, WT112B, WT113B, WTB3, WTG1, WTG3 and WT102A; ranging from 110 to 200 µg/L in WT102C, WT105A, WT114A, WT118B, WTB1, WTB4, WTE1 and WTE3; and ranging from 320 to 880 µg/L in WT1115A, WT116B, WT119A, WT106A, WT111A, WT101A, WT101B and WT101C. Bromide was detected in the sample from WT116A at a concentration of 2,380 µg/L. Sulfate was detected in all of the monitoring well samples with concentrations as low as 0.42 mg/L in the sample from monitoring well WT101C to a concentration of 1260 mg/L in the sample from WT116A. The concentrations in the remaining monitoring wells ranged from 24 to 60 mg/L in WT113A, WTB1, WTB4, WTE3, WTG1, WTG3, WT102B, WT102C, WT105A, WT112B and WT113A; from 131 to 264 mg/L in WT114B, WT115A, WT116B, WT117A, WT106A, WT111A, WT113B, WT114A, WTB3, WT101A, WT101B and WT102A; and from 318 to 434 mg/L in WT117B, WT118B, WT119A, WTE1 and WT112A.

The following discussion refers to the ground water analytical results obtained from the November 2000 sampling event. These detected results are summarized in Table 3-6. Ground water samples were collected from two monitoring wells, WT101A and WT116A. Ethyl ether, dichlorofluoromethane, 1,1-dichloroethane and benzene were detected in samples from both WT116A and WT101A at concentrations of 100 µg/L and 49µg/L; 10 µg/L and 6 µg/L; 9 µg/L and 14 µg/L; and 8 µg/L and 2 µg/L, respectively. 1,2-dichloropropane was detected in the sample from WT116A at

a concentration of 2 µg/L.

No semivolatile compounds were detected in samples from either of the ground water monitoring wells. In addition, no pesticides or PCBs were detected.

Except for antimony, beryllium, cadmium, chromium, mercury, nickel, selenium, silver, thallium, cyanide and vanadium, all of the TAL metals were detected at least once. Aluminum, barium, calcium, iron, magnesium, manganese, potassium, sodium and zinc were detected in both ground water monitoring well samples at concentrations of 335 µg/L and 112 µg/L; 133 µg/L and 79.3 µg/L; 745,000 µg/L and 227,000 µg/L; 8,200 µg/L and 9,490 µg/L; 60,000 µg/L and 20,200 µg/L; 1,240 µg/L and 929 µg/L; 30,800 µg/L and 10,100 µg/L; 214,000 µg/L and 36,700 µ/L; and 85.5 µg/L and 14.9 µg/L, respectively. Arsenic was detected in the sample from WT101A at a concentration of 6.4 µg/L. Cobalt, copper and lead were detected in the sample from WT116A at estimated concentrations of 1.1 µg/L, 2.1 µg/L and 2 µg/L, respectively.

Bromide, sulfate and chloride were detected in the sample from WT116A at concentrations of 3.75 µg/L, 1,020 µg/L and 98.4 mg/L, respectively. Bromide, sulfate and chloride were detected in the sample from WT101A at concentrations of 0.32 µg/L, 177 µg/L and 27.2 mg/L, respectively.

3.5.2.5 Direct-Push Sampling

Ten direct-push ground water samples from four locations were collected and analyzed for TCL volatiles and semivolatile total TAL metals, bromide and sulfate. The direct-push ground water detected analytical results are summarized in Table 3-8. A summary of the data quality evaluation and data usability was presented previously in this chapter. Appendix H contains a summary of the analytical results. The complete data package, corresponding validation reports, and data quality evaluation are presented in Appendix I.

Chloroethane was detected in samples from GPE-1(30-32 feet bgs) and GP101-2 (58-60 feet bgs), both at a concentration of 2 µg/L. Carbon disulfide was detected in four of the ten samples at estimated concentrations ranging from 0.5 to 0.6 µg/L. 1,1-dichloroethane was detected in seven of the ten samples at concentrations ranging from an estimated 0.8 to 5 µg/L. Cis-1,2-dichloroethene was detected in two of the ten samples (two of the same six samples with detections of 1,1-dichloroethane) at concentrations of an estimated 0.7 µg/L from GP114-3 and 1 µg/L from GP114-2. 1,2-dichloropropane was detected in samples from GPE-1 (30-32 feet bgs), GP114-2 (35-37 feet bgs) and GP16-1 (37-39 feet bgs) at concentrations of 0.5 µg/L, 2 µg/L and 2 µg/L, respectively. Trichloroethene was also detected in the sample from GP16-1 (37-39 feet bgs) at a concentration of 0.5 µg/L. Benzene was detected in five of the ten samples collected from the direct push locations (GPE-1, GPE-2, GP114-2, GP114-3, and GP101-1), at concentrations ranging from 0.9 to 2 µg/L.

Bis(2-ethylhexyl)phthalate was detected at concentrations ranging from and estimated 2 to 5 µg/L in four of the ten samples. Phenol was detected in the sample from GPE-3 (41-43 feet bgs) at a

concentration of 5 µg/L.

Except for antimony, beryllium, selenium, silver and thallium, all of the TAL metals were detected at least once. Barium, calcium, magnesium, manganese, potassium and sodium were detected in all of the samples at concentrations ranging from 45.7 to 170 µg/L; 176,000 to 505,000 µg/L; 23,200 to 116,000 µg/L; 309 to 1,820 µg/L; 2,760 to 12,500 µg/L; and 15,300 to 178,000 µg/L, respectively. Aluminum, arsenic, chromium, iron, lead and nickel were detected in all of the samples except for GP114-1 (14.5-16.5 feet bgs) at concentrations ranging from 455 to 11,900 µg/L; 3 to 74 µg/L; 12.6 to 173 µg/L; 12,000 to 71,400 µg/L; 4 to 47 µg/L; and 7 to 64.6 µg/L, respectively. Cadmium and cobalt were detected in all of the samples except for GP114-1 (14.5-16.5 feet bgs), GP114-2 (35-37 feet bgs) and GP101-2 (58-60 feet bgs) at concentrations ranging from 0.1 to 0.6 µg/L and 5.3 to 20.8 µg/L, respectively. Vanadium was detected in all of the samples except GP114-1 (14.5-16.5 feet bgs) and GP114-2 (35-37 feet bgs) at concentrations ranging from 2.5 to 29.9 µg/L, respectively. Copper was detected in sample GPE-2 (35-37 feet bgs) at a concentration of 55.1 µg/L. Mercury was detected in samples GPE-2 (35-37 feet bgs) and GP16-2 (55-57 feet bgs) at concentrations of 0.2 µg/L and 0.1 µg/L, respectively. Zinc was detected in two samples, GP114-3 (55-57 feet bgs) and GP16-2 (55-57 feet bgs), at concentrations of 156 µg/L and 172 µg/L, respectively.

Bromide was detected in all of the samples at estimated concentrations ranging from 40 to 290 µg/L. Bromide was detected in samples from GPE-1 (30-32 feet bgs) and GPE-2 (35-37 feet bgs) at estimated concentrations of 860 and 1,330 µg/L, respectively. Sulfate was also detected in all of the samples at concentrations ranging from 72 to 288 mg/L. Sulfate was detected in samples GPE-1 (30-32 feet bgs) and GPE-2 (35-37 feet bgs) at concentrations of 389 and 654 mg/L, respectively.

3.5.2.6 Emerging Contaminants

One residential ground water well and two site monitoring wells were sampled for analysis of "Emerging Contaminants". "Emerging Contaminants" is the term initially given to those Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants that could be attributable to human or animal wastewater. The samples were collected, as part of a national reconnaissance by the US Geological Survey (USGS), using newly developed laboratory methods to provide baseline information on the environmental occurrence of these contaminants in ground water wells susceptible to animal or human waste sources. Fifty-six wells were sampled across 17 states in 2000. As with an earlier stream reconnaissance study, site selection was focused on wells suspected to be susceptible to contamination (e.g. downgradient from landfills, etc.). Thus, wells sampled were not necessarily used as sources of drinking water. All samples were collected by USGS personnel using consistent protocols and procedures. Data are currently being analyzed and interpreted by the USGS and are provided in Table 3-9 for information only.

4.0 GROUND WATER INVESTIGATION OVERVIEW

This chapter presents an overview of the ground water portions of all investigations conducted at the Site between 1978 and 2000. A summary of the ground water monitoring network, sampling methodology and laboratory analytical data validation issues that could potentially affect the data usability are presented herein for each investigation. All ground water data are evaluated using a set of criteria established below in order to determine if the various data are useable in a quantitative manner or to qualitatively support the risk assessment which follows in this report.

4.1 Criteria for Use of Site Ground Water Analytical Data

Over the past two decades, numerous investigations have been completed at the Site. Each investigation has resulted in a ground water analytical data set which was collected to meet specific, but often different, Data Quality Objectives. In order to evaluate all of the existing site ground water analytical data for quantitative or qualitative usability in assessing the potential risk from exposure to ground water, the following five criteria have been established. All available data, regardless of usability in the toxicity assessment, were retained for potential use in interpreting ground water flow rates and evaluating contaminant transport processes.

- Ground water samples must have been collected using a sample collection methodology which does not artificially increase constituent concentrations in the ground water, also referred to as a positive bias. Ground water sampling methods which do not cause constituent concentrations to significantly decrease (negative bias) are acceptable as long as the resulting risk evaluation using these data is recognized as potentially underestimating the quantifiable risk from exposure to ground water.

- For metals analyses, only the data obtained from unfiltered samples (total concentrations) with sample turbidity measurements less than 50 NTU's may be used in the quantitative risk assessment. Data from filtered samples (dissolved concentrations) will not be used in the quantitative risk assessment.

- Documentation of the sample collection activities must be available, including the sample collection device, volume of water removed during purging, sample handling and preservation, water quality parameters measured during the purge process, and times in which any measurements or observations were made.

- For the time period the samples were collected, the data generated must have used the accepted USEPA analytical methods and standards.

- The data must have been validated in accordance or consistent with the National Functional Guidelines or the quality criteria contained in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition, or USEPA Drinking Water Standards,

1996, using the criteria established in the approved site specific QAPP and QAPP Addendums.

A given analytical data set must meet all of the above criteria to be considered for use in the quantitative risk assessment which follows in this report. If the data set does not meet all of the specified criteria, then the data may be used qualitatively to provide clarification and support the quantitative risk assessment. This may be accomplished by filling data gaps, providing documentation on the variability of contaminant concentrations found in the site ground water wells, or supporting the data used in the quantitative risk assessment.

4.2 Summary of Site Investigations

There have been a number of investigations of the Site, beginning with the initial USGS investigation in 1978, through the USEPA/USGS/USACE sampling events in 2000. Some monitoring wells have been sampled throughout all the investigations, and new monitoring wells have been added during many of the later investigations. Other monitoring wells have been destroyed or decommissioned through the years. Table 2-3 lists all relevant Site monitoring wells located within the study area and their construction information, if known. Monitoring wells are considered relevant if they have been used to monitor the ground water contaminant plume emanating from the Site, or are appropriate background wells. All of these existing and past monitoring wells listed in Table 2-3 are shown either in Figure 1-1 or Figure 2-1. Table 2-1 provides a summary of all known sampling events involving these monitoring wells, along with the parameters sampled and analyzed for. Table 2-2 provides a summary of all known sampling events involving residential water wells immediately adjacent to the southern and eastern perimeters of the Site, along with the parameters sampled and analyzed for. The location of these residential wells can be found in Figure 2-1. A brief summary of all investigations for the Site is provided in the following sub-sections. For in-depth discussion of sampling methods and analytical results, the cited reports should be consulted.

4.2.1 Summary of Pre-1990 USGS Ground Water Investigations

Two investigations involving the chemical evaluation of ground water in Elkhart County were completed by the USGS between 1978 and 1989 (Imbrigiotta and Martin, 1981; Duwelius and Silcox, 1991). The first investigation (Imbrigiotta and Martin, 1981) was designed to evaluate the water resources and the water quality in northwest Elkhart County, and to define the areal extent of the ground water impacted by the Site and another area within the Elkhart City limits identified as the industrial park. During this investigation, all of the USGS monitoring wells were installed, and extensive geochemical sampling, hydrogeological characterization and ground water modeling were completed. The second USGS investigation (Duwelius and Silcox, 1991) focused on the area surrounding the Site and potential downgradient locations. Regular monitoring of ground water flow directions was an integral part of this investigation. However, this second investigation was not as focused on the geochemical parameters sampled and analyzed for.

During the first USGS investigation (Imbrigiotta and Martin, 1981), a portion of the overall sampling well network consisted of a group of 45 monitoring wells found at 17 locations either upgradient or downgradient of the Site. Thirty-seven of these wells are located within the study area (Figure 1-1), and have been included in the set of monitoring wells whose ground water analytical data is available for use in the risk assessment which follows in this report. These 37 wells are referred to as "landfill" wells in the USGS report, and may be identified by the letters "WT" (which Donohue added and has been used in subsequent USEPA funded reports) followed by a site letter B through Q (except CP1), followed by a single digit number (Table 2-3). Each monitoring well location that contained more than one well in close proximity is defined as a well cluster. Although these well clusters had wells that were screened at different depths to determine the vertical extent of contaminant migration, no criteria was used to determine the vertical screened intervals.

During the first USGS investigation, ground water samples were collected from the landfill wells in April-May and October of 1978, and April-May and September of 1979. All monitoring wells were not consistently sampled over all four sampling events (Table 2-1).

The ground water field sampling procedures and analyses were consistent throughout this investigation. The field analyses included determinations of temperature, pH, specific conductance, ORP, dissolved oxygen and total alkalinity. Laboratory analyses included the measurement of some combination of the following: major dissolved constituents (calcium, magnesium, sodium, potassium, chloride, bicarbonate, sulfate, fluoride, silica, and bromide); selected dissolved trace elements (iron, manganese, aluminum, mercury, arsenic, selenium, lead, chromium, cadmium, barium, and boron); dissolved nutrients (ammonia, nitrate, nitrite, organic nitrogen, and orthophosphate); total cyanide; total hardness; dissolved solids; dissolved organic carbon; and several specific groups of organic compounds including phenols, volatile organics, and base/neutral extractable organics (Table 2-1). The laboratory analyses were performed using state of the art analytical technologies for the time, that continue to be used today (Skougstad and others, 1979; USEPA, 1979).

Sufficient well construction details were provided by Duwelius and Silcox (1991) to determine that some of the monitoring wells are constructed of casing material which may be unacceptable for certain inorganic analyses. Black steel was used in the construction of 6 landfill wells (Table 2-3). PVC and galvanized steel were used to construct the remainder of the monitoring wells. Metallic casings (black steel) are subject to corrosion, which may produce a positive bias in analytical data for some metals and ions, and a negative bias for chlorinated compounds.

All monitoring wells were purged using a centrifugal pump; however, sampling for all the constituents listed above was performed using a peristaltic pump. Changing out pumps between purging and sampling may produce a positive bias in the metals/ions analytical data by disturbing sediments in the well and/or the filter pack, and a negative bias in the VOC analytical data by aerating the sample. In addition, peristaltic pumps may produce a negative bias in analytical data for VOC's and redox sensitive constituents such as some metals and ions due to the negative

pressure imparted on the sample during the collection process. Finally, turbidity measurements were not obtained during the purging process.

No indication of a quality assurance plan prepared to support the collection and analysis of reliable and defensible samples could be located. This level of effort was not standard practice at the time and does not necessarily detract from the quality of the data. However, without a Quality Assurance (QA) plan and a subsequent systematic review to support the technical and legal defensibility of the data, it is impossible to verify the validity of the data produced.

Based on a review of the available documentation, all laboratory analytical data from this first USGS investigation are usable to qualitatively support the risk assessment which follows in this report. Major constituents, trace elements, nutrients, cyanide, hardness, dissolved solids, and dissolved organic carbon data are unusable for quantitative use either because dissolved concentrations were reported and/or no data validation exists to verify the concentrations reported. The organic compound data are unusable for quantitative use because of the lack of data validation.

The second USGS investigation (Duwelius and Silcox, 1991), performed in cooperation with the Elkhart Water Works, involved the collection of ground water quality samples and water levels from selected monitoring wells between 1980 and 1989. Ground water samples were collected from a subset of 26 out of the 45 total landfill wells during this second USGS investigation. All 26 landfill wells are located within the study area, and have been included in the set of monitoring wells whose ground water analytical data are available for use in the risk assessment which follows in this report.

Ground water samples were generally collected once a year in the summer (July or August) with some exceptions (Table 2-1). Sampling was initiated in 1980, and continued through 1989. The first set of ground water samples were collected during November and December of 1980. No ground water samples were collected in 1981 from any of the wells. Two wells were sampled twice in 1984, once in the summer (July) and once in the winter (December). Four monitoring wells were sampled in all but one of the sampling events. In summary, a total of 8 to 10 ground water samples for chemical analyses were obtained from each of the 26 monitoring wells from 1980 to 1989.

Water samples were collected and analyzed to determine the concentrations of some combination of the following: dissolved bromide, sulfate, sodium and potassium (Table 2-1). Field measurements of temperature, pH, specific conductance, dissolved oxygen and total alkalinity were made at the time of sampling.

The procedures for the collection and analysis of ground water samples in this investigation are similar to those documented in the first USGS investigation with the exception that three types of pumps were used instead of one during the sampling process, and included submersible, centrifugal, and peristaltic pumps. The type of pump initially used for purging depended on the depth to water, the volume of water in the well, and the casing diameter. Following the evacuation of a minimum of three well volumes to ensure that the water sample was representative of water in the aquifer, a

sample was obtained for bromide analysis using a peristaltic pump. It was also noted that turbidity measurements were not obtained once again during the purging and sampling process.

As with the first investigation, there is no indication of a QA plan or data review and validation.

Based on the fact that there is no way to verify the validity of the results, data from this second USGS investigation are usable to qualitatively support the risk assessment which follows in this report.

4.2.2 Summary of 1984 Site Investigation

A Hazard Ranking System scoring package for the Site was prepared in 1984 by a USEPA field investigation team. This package was completed by FIT team members from Ecology and Environment, Inc. Limited geochemical sampling of ground water, surface water and sediment was performed as part of the overall evaluation of the Site.

Ground water samples were obtained from 8 of the existing USGS landfill wells in July of 1984 (Table 2-1). All 8 of these landfill wells are located within the study area, and have been included in the set of monitoring wells whose ground water analytical data are available for use in the risk assessment which follows in this report. Laboratory analyses included volatile and semivolatile organic compounds, PCB's, pesticides, and metals plus cyanide and tin. It is unclear whether the metals data are total or dissolved, and no turbidity data are available.

No documentation was found detailing the equipment and methodology used to obtain the samples.

Based on the fact that no documentation on the field sampling equipment and methodology could be found, data from this 1984 Site Investigation are unusable for quantitative use or to qualitatively support the risk assessment which follows in this report.

4.2.3 Summary of 1990-1991 Remedial Investigation

The Remedial Investigation for the Site was completed by SEC Donohue between 1990 and 1991 (Donohue, 1992). This investigation was performed to determine the nature, extent, and sources of contamination at the Site, to conduct human health and ecological risk assessments, and to complete a feasibility study. Field work for the RI was performed in two phases. The first phase (Phase I) of field activities was conducted between October 1990 and February 1991. The Phase I field investigation included waste characterization, geophysical surveys, test pit excavations, wetlands determination, installation of monitoring wells, and geochemical sampling of soils, sediment, surface water, ground water, landfill waste mass gas and residential basement gas. The second phase (Phase II) of field activities took place in September and November of 1991. The primary purpose of the Phase II field investigation was to gather additional information regarding leachate, ground water, soil, surface water and sediment.

Phase I ground water sampling activities included the installation of a total of 10 ground water monitoring wells at 6 locations around the landfill mostly as well clusters (Figure 2-1). These wells are identified by the letters "WT" followed by a 3-digit number starting with 101 and ending at 106, followed by a single letter (A, B or C) denoting depth (Table 2-3). Vertical screened intervals for the monitoring wells were pre-determined prior to the initiation of all field work, and were not based on any criteria. A total of 36 ground water samples were collected during Phase I. These ground water samples were obtained from 23 existing monitoring wells and the 10 newly installed monitoring wells (Table 2-1). Three of the newly installed monitoring wells (WT102A, WT105A, and WT106A) were sampled twice during the course of Phase I field activities, once in November 1990 and once in January 1991. Ground water samples were also obtained from residential wells during Phase I of the RI. A total of 8 residential wells located to the south of the landfill were sampled once (Table 2-2). The location of these wells can be found in Figure 2-1, and are numbered RW-01 through RW-08.

Phase II field activities included the installation of 1 monitoring well (WT111A) and the collection of 19 ground water samples from 8 existing monitoring wells and 11 newly installed monitoring wells, including those installed in Phase I and Phase II (Table 2-1). Once again, the vertical screened interval for the monitoring well was pre-determined prior to the start of field work, and was not based on any criteria. No residential water well sampling was performed during the Phase II field activities.

All monitoring wells installed and sampled during the RI (Phase I and Phase II) consist of stainless-steel screen and riser pipe. Existing monitoring wells sampled during the RI consist of PVC well screen and riser pipe with the exception of WTCP1, which was constructed of galvanized metal. Ground water samples collected during the first phase of field work were analyzed according to analytical procedures set forth in the USEPA Contract Laboratory Program (CLP) Routine Analytical Services (RAS) SOW 2/88 for volatile organic compounds, semivolatile organic compounds, pesticide, and PCB's. Total and dissolved TAL metals plus cyanide were analyzed using CLP RAS SOW 7/88 while the dissolved bromide, and water quality parameters were analyzed in accordance with the Special Analytical Services prescribed in the site specific QAPP. A complete list of the water quality parameters analyzed for can be found at the bottom of Table 2-1. The second phase of water quality data was likely analyzed using the same SOW's as in the first round, but could have been analyzed consistent with the new USEPA CLP SOW for Organic Analysis OLM01.8 (8/91) and Inorganic Analysis ILM02.1 (9/91).

A variety of equipment was used in both phases of the RI for obtaining ground water samples. The majority of the monitoring wells were purged and sampled using a 2-inch diameter Keck submersible pump. Larger diameter (5-inch) wells were purged using either a 3-inch or 4-inch diameter submersible pump capable of higher pump rates. Purge rates up to 20 gpm in Phase I, and 30 gpm in Phase II, were attained while purging the 5-inch diameter wells. The 2-inch diameter Keck submersible pump was used to sample these wells following purging. Monitoring wells WTF1 and WTF5 were purged and sampled with a bailer during Phase I supposedly due to the small casing

diameter. The following monitoring wells were purged and sampled with a bailer during Phase II: WT101A, WT103A, WT104A, WTB2, WTCP1, WTE2, WTM2, and WTP1. Monitoring wells WTB2, WTE2, WTM2 and WTP1 had a kink or obstruction in the well casing which prevented purging and sampling with the Keck submersible pump. A bailer was used to purge and sample the other four wells listed above to keep field team members busy and to finish the ground water sampling effort on schedule. Changing out pumps between purging and sampling, and the use of a bailer to obtain ground water samples may produce a positive bias in the metals/ions analytical data by disturbing sediments in the well and/or the filter pack, and a negative bias in the VOC analytical data by aerating the sample.

The Field Sampling Plan for Phase I activities (Donohue, 1990), and Addendum I Field Sampling Plan for Phase II activities (Donohue, 1991), state that turbidity will be recorded during the purging of monitoring wells; however, the work plans did not specify that a turbidimeter would be used. Turbidity was noted on field sampling forms qualitatively using terms such as "slight", "clear", and "yes" or "no". Without a clear quantification of the sample turbidity, the impact of suspended particulates on the metals/ions results is unmeasurable.

A total of 8 residential water wells located to the south of the landfill were sampled during Phase I of the RI. According to the Final RI Report (Donohue, 1992), two of these wells (RW-02 and RW-05) are the original wells installed for the residences, and are relatively shallow in depth (approximately 22 below ground surface). The six other residential wells sampled during the RI were installed in 1974 to replace the original residential wells. These replacement wells are considerably deeper (152 to 172 feet below ground surface). A records search was performed using the Online Water Well Record Database of the Indiana Department of Natural Resources to find construction details for all 8 residential wells that were sampled during the RI. Construction details for the 6 deeper wells were obtained and the depths of the wells were verified. No records were found to confirm the depth of the older shallow wells.

Sampling of the deeper wells consisted of opening an inside tap located either in the kitchen or basement, and letting it run for approximately 5 minutes prior to obtaining a sample. Sampling locations were ahead of any water softener devices that may have been located in the residences. Shallow residential wells were purged and sampled by bailer at the well head. No turbidity readings were obtained while purging or sampling any of the residential wells.

All residential water well samples were analyzed for the same suite of analytes as ground water samples from the monitoring wells.

The CLP SOW's and QAPP SAS provided the requirements for calibration and internal quality control procedures used to verify and document the analytical precision and accuracy of the RI Phase I and Phase II sample analysis. The data generated were subsequently validated using the protocols specified in the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (USEPA, 1988a) and Inorganic Analyses (USEPA, 1988b). The data sets are technically

and legally defensible and acceptable for use as qualified.

Based on a review of the documented sampling procedures for monitoring and residential wells, metals/cyanide data collected during both phases of the RI are unuseable in a quantitative manner or to qualitatively support the risk assessment which follows in this report primarily because no turbidity measurements were obtained. All other analytical data (volatile and semivolatile organic compounds, pesticides, PCB's, bromide and water quality parameter) collected from monitoring and residential wells during the RI are usable in a quantitative manner and to qualitatively support the risk assessment. Caution should be applied when quantitatively using the VOC analytical data obtained from the 5-inch diameter monitoring wells (WTB1, WTB3, WTB4, WTE3, WTF2, WTG1, WTG3, WTI1, WTI3, WTJ1, and WTJ3), those monitoring wells which were sampled with a bailer during Phase I (WTF1 and WTF5) and Phase II (WT101A, WT103A, WT104A, WTB2, WTCP1, WTE2, WTM2, and WTP1), and those residential wells also sampled with a bailer (RW-02 and RW-05) due to the potential for negative bias in the data.

4.2.4 Summary of 1995 Pre-Design Field Investigation

The Pre-Design Field Investigation for the Site was completed by the USACE Omaha District between July and October of 1995 (USACE, 1996). This investigation was designed to supplement the available technical data from the Remedial Investigation and to further characterize the Site in order to develop a detailed design for the selected remedial action. During this investigation, additional ground water monitoring wells were installed and others were abandoned, geotechnical sampling of soils and geochemical sampling of ground water and soil gas was completed, and a visual inspection of existing monitoring and residential wells was performed.

A total of 12 additional ground water monitoring wells were installed at 7 locations around the landfill mostly as well clusters (Figure 2-1). These wells are identified by the letters "WT" followed by a 3-digit number starting with 112 and ending at 118, followed by a single letter (A or B) denoting depth (Table 2-3). The vertical placement of the well screens was determined prior to the start of field work and is consistent with the screen intervals of monitoring wells installed during the RI. Ground water samples were collected from these wells along with 7 of the existing wells for a total of 19 ground water samples (Table 2-1).

All monitoring wells installed and sampled during the Pre-Design Field Investigation consist of PVC screen and riser pipe. Existing monitoring wells sampled during the Pre-Design Field Investigation consist of either PVC or stainless-steel well screen and riser pipe. Ground water samples collected during the Pre-Design Field Investigation were analyzed in accordance with the Himco RI QAPP and QAPP addendum specifying TCL VOC's, TCL SVOC's, and TCL pesticides/PCB's using USEPA CLP SOW for Organic Analysis OLM01.8 (8/91), and total TAL metals plus cyanide using Inorganic Analysis ILM02.1 (9/91).

Purging and sampling of all monitoring wells was done in a manner which minimized agitation or aeration of the well water. A Grundfos Redi-Flow II submersible pump with dedicated Teflon-lined polyethylene tubing was used for all purging and sampling. Purge rates ranged from approximately 0.1 to 2 gpm, with a sampling rate which approached the lower limit of the pump, ranging from 500 to 1000 milliliters per minute (ml/min). Low sampling rates were chosen to minimize the suspension of particulate matter which could affect the analytical results, and to more closely approximate ground water flow conditions.

The CLP SOW's and QAPP Addendum provide the requirements for calibration and internal quality control procedures used to verify and document the analytical precision and accuracy of the sample analysis. The data generated were subsequently validated using the protocols specified in the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic (USEPA, 1994a) and Organic (USEPA, 1994b) Data Review. The data sets are technically and legally defensible and acceptable for use as qualified.

All ground water analytical data (volatile and semivolatile organic compounds, pesticides, PCB's and metals/cyanide) collected during the Pre-Design Field Investigation meet the five criteria established in Section 4.1 and are usable in a quantitative manner and to qualitatively support the risk assessment which follows in this report.

4.2.5 Summary of 1996 Supplemental Site Investigation

Details pertaining to the ground water monitoring network, documentation of sampling activities, laboratory analytical methods, and data validation can be found in Chapters 2 and 3 of this report. A list of the monitoring wells sampled, along with the parameters analyzed for, can be found in Table 2-1. All ground water analytical data (volatile and semivolatile organic compounds, and metals) collected during the 1996 Supplemental Site Investigation meet the five criteria established in Section 4.1. Therefore, these data are usable in a quantitative manner and to qualitatively support the risk assessment which follows in this report. Caution should be applied when using the VOC analytical data obtained from monitoring well WT116A due to the potential for negative bias in the data as a result of the sampling method used.

4.2.6 Summary of 1998 Supplemental Site Investigation

Details pertaining to the ground water monitoring network, documentation of sampling activities, laboratory analytical methods, and data validation can be found in Chapters 2 and 3 of this report. A list of the monitoring wells sampled, along with the parameters analyzed for, can be found in Table 2-1. All ground water analytical data (volatile and semivolatile organic compounds, and metals/cyanide) collected during the 1998 Supplemental Site Investigation meet the five criteria established in Section 4.1. Therefore these data are usable in a quantitative manner and to qualitatively support the risk assessment which follows in this report.

4.2.7 Summary of 2000 Supplemental Site Investigation

Details pertaining to the ground water monitoring network, documentation of sampling activities, laboratory analytical methods, and data validation can be found in Chapters 2 and 3 of this report. A list of the monitoring and residential wells sampled, along with the parameters analyzed for, can be found in Tables 2-1 and 2-2, respectively.

All ground water analytical data (volatile and semivolatile organic compounds, metals, bromide and sulfate) collected from monitoring wells during the April/May 2000 sampling event, with the exception of WTB1, WT102C, WT106A and WT115A, meet the five criteria established in Section 4.1, and are usable in a quantitative manner and to qualitatively support the risk assessment which follows in this report. All analytical data from WTB1 are usable to qualitatively support the risk assessment. Ground water sampling was not conducted in this well to support a quantitative risk assessment. This well was sampled mainly to verify the presence or absence of volatile organic compounds at considerable depth within the aquifer, and the method used to obtain the ground water sample was quite different compared to sampling all other monitoring wells. Metals data from WT102C are unusable in a quantitative manner or to qualitatively support the risk assessment as turbidity readings are noted as questionable. Although the reported turbidity readings are quite low, there is no documentation as to whether the sample was visually clear. Without some indication of the quantitative nature of the sample turbidity, the data should not be used to support the risk assessment in any manner. Metals data from WT106A and WT115A are unusable in a quantitative manner or to qualitatively support the risk assessment as final turbidity readings were well above 50 NTU's.

The volatile and semivolatile organic compounds, PCB's, pesticides, metals/cyanide, bromide, sulfate, and chloride analytical data collected from monitoring wells during the November 2000 sampling event meet the five criteria established in Section 4.1, and are usable in a quantitative manner and to qualitatively support the risk assessment which follows in this report. The emerging contaminants data were not generated using accepted USEPA analytical methods and were not validated. Therefore, the emerging contaminant data do not meet all of the five criteria established in Section 4.1 and are unusable for quantitative use. Additionally, these data were collected for information purposes only; therefore, they will not be used to qualitatively support the risk assessment.

The direct-push analytical data, collected during the April/May 2000 sampling event, meet the five criteria established in Section 4.1, and are usable in a quantitative manner and to qualitatively support the risk assessment which follows in this report with the exception of the metals data. Metals data from all direct-push samples collected during the April/May 2000 sampling event are unusable in a quantitative manner or to qualitatively support the risk assessment as all samples were extremely turbid.

The residential well analytical data, collected during the March, April/May and November 2000 sampling events, meet the five criteria established in Section 4.1, and are usable in a quantitative manner and to qualitatively support the risk assessment which follows in this report with the exception of the metals/cyanide data collected during the March and April/May 2000 and the emerging contaminants data. The metals data obtained from residential water well samples collected during the March and April/May 2000 sampling events are unusable in a quantitative manner or to qualitatively support the risk assessment as no turbidity measurements were obtained during the sampling process. The emerging contaminants data do not meet all of the five criteria established in Section 4.1, as discussed above for the monitoring well data. Additionally, these data were collected for information purposes only.

5.0 SUPPLEMENTAL SITE INVESTIGATION SOIL GAS RESULTS

This chapter presents the findings of the supplemental soil gas investigations performed in 1998 and 1999 for the Himco Dump Site. Included is a characterization of the chemicals found, their distribution at the site, and a brief summary of the data quality and sample limitations. The soil gas samples were analyzed by Air Toxics Ltd., Folsom, California, using SW-846 Method 5041A/8260B. The results were validated by USEPA Region 5.

5.1 1998 Supplemental Site Investigation Analytical Results

5.1.1 Data Qualifiers and Limitations

QC checks were performed routinely during data collection and analysis to verify that the data collected are of appropriate quality for the intended use and that the data quality objectives were met.

There are general areas of data qualification that were necessary based on initial or continuing calibration and internal standard or surrogate recoveries. The qualification was primarily in the estimation of the affected results, and are not discussed in detail here. There are a few instances where the data are unusable and are qualified as rejected "R".

5.1.1.1 Data Qualifiers

The data were reviewed in the laboratory and qualifiers were applied as required by the Scope of Work. The data were then validated which resulted in additional qualifiers, as needed, to support the data usability.

The following conventions have been applied to the data set as it is presented in Tables 5-1 and 5-2. Appendix I contains the original laboratory reports and validation results that support the data qualification. The data summary tables accompanying Appendix I also reflect all qualifiers added by the laboratory and the data reviewers.

- All data that are estimated, regardless of the concentration reported, have been qualified "J".
- Qualifiers based on blank contamination: All samples that contain an analyte that is also present in a trip blank, equipment rinse blank or laboratory method blank, are qualified "B" unless the amount present is less than ten times the blank concentration for the common laboratory contaminants or five times the amount present in the blank for all other analytes. If the amount present in the sample is less than ten times the amount present in the blank for the common laboratory contaminants, or five times the amount present in the blank for any other analyte, the result is qualified "UB".

5.1.1.2 Data Limitations

The samples discussed below have specific limitations and should be used with caution.

- The presence of ethyl benzene and m,p-xylene in the soil gas sample collected from TT-12 may not be indictive of subsurface soil gas concentrations at that location because the ambient air blank and equipment blank collected just before this sample demonstrated the presence of low levels of benzene, toluene, ethyl benzene, xylenes, styrene, and carbon tetrachloride. A complete discussion blank contamination is presented in Chapter 2 and Appendix I-1.

- Tetrachloroethene was not detected in the ambient air blank but was detected in the equipment blank collected just before the soil gas sample collection at location TT-27. However, the low concentration reported in the blank does not account for the high concentrations reported in soil gas sample TT-27.

- The tetrachloroethene detection in sample TT-32, the xylene detection in sample TT-16, and the toluene detection in samples TT-35, TT-36, TT-37 and TT-38 are suspect because the low concentrations reported are consistent with the concentrations reported for the trip blanks that were included for shipment.

- The concentration of 1,1- dichloroethane is estimated in the soil vapor sample collected from TT-14 due to poor precision between the primary and duplicate sample.

The data met the data quality objectives for precision, accuracy, representativeness, comparability and completeness, and are adequate for its intended use except for sensitivity and as noted above.

5.1.2 Soil Gas Analytical Data

A total of 43 soil vapor samples and two duplicates were collected from the area adjacent to the southern side of the landfill and analyzed for VOC's and TIC's. The method of sample collection is detailed in Chapter 2. The laboratory reported soil vapor analytical results in nanograms (ng) of analyte per sorbent tube. For presentation purposes, the laboratory results were converted to micrograms of analyte per cubic meter of soil gas ($\mu g/m^3$) sampled based on the measured volume of soil gas aspirated through each sorbent tube. The results are summarized in Table 5-1.

The compounds detected in the soil gas are:

-carbon disulfide;
-BTEX compounds (benzene, toluene, ethyl benzene, and xylenes);
-chlorinated ethenes (tetrachloroethene, trichloroethene, dichloroethenes, and vinyl chloride);
-chlorinated ethanes (chloroethane, 1,1,1-trichloroethane, and 1,1-dichloroethane).

Figures 5-1 through 5-3 present the contoured concentration data for various compound classes (BTEX, chlorinated ethenes, and chlorinated ethanes), and Figure 5-4 presents the contoured concentration data for vinyl chloride. These figures illustrate the approximate extent of soil vapor migration at the time the sorbent tube samples were collected. All the compounds listed above were found along the entire length of the southern perimeter of the landfill where sampling was performed. The highest concentrations of BTEX were found at sample locations TT-13, TT-18 and TT-26 (Figure 5-1). The highest concentrations of chlorinated ethenes were found at sample locations TT-14, TT-19 and TT-26 (Figure 5-2). The highest concentrations of chlorinated ethanes were found at sample locations TT-14, TT-26 and TT-45 (Figure 5-3). Vinyl chloride was included in the group of compounds labeled chlorinated ethenes, whose data was contoured and presented in Figure 5-2. Vinyl chloride data was also individually contoured (Figure 5-4) to determine the horizontal extent of this single compound. The vinyl chloride follows the same basic pattern as all the other compound classes, and does not appear to have migrated any further from the landfill boundary. The highest concentrations of vinyl chloride were found at locations TT-14, TT-19 and TT-26.

All detected compounds appear to be distributed similarly, with higher concentrations measured just off the south boundary of the landfill, and a trend of decreasing concentrations moving away from the landfill perimeter. In all cases, the highest detected concentrations were found in the southeast corner of the site (sample location TT-26) just northwest of the intersection of County Road 10 and John Weaver Parkway. The limit of soil gas contamination appears to have been delineated with the exception of the east side of John Weaver Parkway, where chlorinated ethenes were detected at sample locations TT-35, TT-36, TT-37 and TT-38.

5.2 1999 Supplemental Site Investigation Analytical Results

5.2.1 Data Qualifiers and Limitations

QC checks were performed routinely during data collection and analysis to verify that the data collected are of appropriate quality for the intended use and that the data quality objectives were met.

There are general areas of data qualification that were necessary based on initial or continuing calibration and internal standard or surrogate recoveries. The qualification was primarily in the estimation of the affected results, and are not discussed in detail here. There are a few instances where the data is unusable and is qualified as rejected "R".

5.2.1.1 Data Qualifiers

The data were reviewed in the laboratory and qualifiers were applied as required by the Scope of Work. The data were then validated by a third party. This validation resulted in additional qualifiers, as needed, to support the data usability.

The following conventions have been applied to the data set as it is presented in Table 5-2. Appendix I contains the original laboratory reports and validation results that support the data qualification. The data summary tables accompanying Appendix I also reflect all qualifiers added by the laboratory and the data reviewers.

- All data that are estimated, regardless of the concentration reported, have been qualified "J".

- Qualifiers based on blank contamination: All samples that contain an analyte that is also present in a trip blank, equipment rinse blank or laboratory method blank, are qualified "B" unless the amount present is less than ten times the blank concentration for the common laboratory contaminants or five times the amount present in the blank for all other analytes. If the amount present in the sample is less than ten times the amount present in the blank for the common laboratory contaminants, or five times the amount present in the blank for any other analyte, the result is qualified "UB".

5.2.1.2 Data Limitations

The samples discussed below have specific limitations and should be used with caution.

- The presence of Freon 11 and carbon tetrachloride in soil gas samples collected from TT-71 and TT-96 may not be indicative of subsurface soil gas concentrations at those locations because these compounds were detected at similar concentrations in the ambient air blanks and equipment blanks collected just prior to the sample collection. A complete discussion of the potential impact to the site samples can be found in Appendix I-2.

- Sample 11020 (location TT-85) was lost during analysis when the mass spectrometer filament broke. There is no valid data from this location.

- Cartridge 11021A (TT-61) was inadvertently analyzed with cartridge 11009B (TT-54) while 11009A (TT-54) and 11021B (TT-61) were analyzed independently. The corresponding detections have been qualified "J". The contaminants detected in the pair 11021A/11009B can likely be attributed to location TT-61. The rationale behind this reasoning lies in the sample collection method. During collection, the soil gas was drawn through sorbent tube "A" before passing through tube "B". At those locations with high concentrations, tube "A" would saturate with the residual passing to sorbent tube "B". The sorbent tube "A" from location TT-54 demonstrated only a trace of toluene and carbon disulfide. All other compounds were non-detect. If the levels reported in the pair 11021A/11009B were from location TT-54, then the concentrations from the analysis of sorbent tube "A" from that location would have been higher than observed in the pair which contained the residual portion of the sampling. Further supporting this is the concentration of residual tetrachloroethene reported in sorbent tube 11021B (TT-61). Similar relationships are noted among the other contaminants reported. The impact to the data is in the estimation of the concentration detected and not the presence or

absence.

The data met the data quality objectives for precision, accuracy, representativeness, comparability and completeness, and are adequate for its intended use except as noted above.

5.2.2 Soil Gas Analytical Data

A total of 49 soil vapor samples and 3 duplicate samples were collected from the area adjacent to eastern side of the landfill and analyzed for VOC's and TIC's. The method of sample collection is detailed in Chapter 2. The laboratory reported soil vapor analytical results in nanograms of analyte per sorbent tube. For presentation purposes, the laboratory results were converted to micrograms of analyte per cubic meter of soil gas sampled based on the measured volume of soil gas aspirated through each sorbent tube. These results are summarized in Table 5-2.

The compounds detected in the soil gas are:

-carbon disulfide;
-styrene;
-dichlorobenzenes;
-1,2-dichloropropane;
-BTEX compounds (benzene, toluene, ethyl benzene, and xylenes);
-chlorinated ethenes (tetrachloroethene, trichloroethene, dichloroethenes, and vinyl chloride);
-chlorinated ethanes (chloroethane, 1,1,1-trichloroethane, 1,1-dichloroethene, and 1,1-dichloroethane);
-halogenated methanes (bromomethane, chloroform, chloromethane, methylene chloride);
-Freon 11;
-ketone compounds (acetone, 2-butanone, 4-methyl-2-pentanone).

Figures 5-5 through 5-7 present the contoured concentration data for the compound classes BTEX, chlorinated ethenes, and chlorinated ethanes. These figures illustrate the approximate extent of soil vapor migration at the time the sorbent tube samples were collected. BTEX and chlorinated ethenes were found along the entire eastern perimeter of the landfill where sampling was performed. Chlorinated ethanes were found along the southern half of the eastern perimeter of the landfill. The highest concentrations of BTEX were found along the southeast side of the landfill at sample locations TT-56, TT-62, TT-63 and TT-64 (Figure 5-5). The highest concentrations of chlorinated ethenes and chlorinated ethanes were also found at sample locations TT-56, TT-62, TT-63 and TT-64 (Figure 5-6 and 5-7); however, the chlorinated ethanes were detected at lower concentrations compared to the chlorinated ethenes.

All detected compounds appear to be distributed similarly, with higher concentrations measured just off the boundary of the landfill, and a trend of decreasing concentrations moving away from the landfill perimeter. Except for isolated detections of BTEX at sample locations TT-59 (1.99 $\mu g/m^3$) and TT-95

(0.83 $\mu g/m^3$), chlorinated ethenes at sample location TT-95 (1.30 $\mu g/m^3$), and chlorinated ethanes at sample locations TT-75 (0.80 $\mu g/m^3$) and TT-102 (0.82 $\mu g/m^3$), the extent of detectable contamination has been delineated. In all cases, the results are consistent with observations from the previous soil gas investigation conducted in 1998 where the highest detected concentrations were found in the southeast corner of the site just northwest of the intersection of County Road 10 and John Weaver Parkway.

5.3 Restrictions and Recommendations on Data Use

The data met the data quality objectives for precision, accuracy, representativeness, comparability, and completeness and are adequate for its intended use except as noted above, provided it retains the data qualifiers.

6.0 SUPPLEMENTAL SITE INVESTIGATION CDA SOIL RESULTS

This chapter presents the findings of the CDA supplemental soil investigation performed in 1998 for the Himco Dump Site. Included is a characterization of the chemicals found, their distribution across the CDA, and a brief summary of the data quality and sampling limitations.

6.1 Identification of Construction Debris Area

The CDA bordering the southern perimeter of the landfill consists of construction rubble mixed with non-native soil. Numerous small piles of rubble, concrete, asphalt, and metal debris are scattered throughout the area; however, the calcium sulfate layer found at the landfill is not present in the CDA. The CDA is approximately 4 acres in size and is subdivided into seven residential and one commercial property parcels (Figure 1-2). The residential parcels are currently occupied. The existing homes on these residential parcels are connected to a municipal water supply; however, some of the homes also have operable water wells. The commercial property is not currently occupied or being used for any purpose. The CDA and it's boundaries are defined primarily from 13 test trenches excavated in 1991 during the second phase of field studies for the RI. The location of 10 out of the 13 test trenches can be found in Figure 2-2.

6.2 1998 Supplemental Site Investigation Analytical Results

Forty-seven soil samples were collected from 18 locations during the 1998 Supplemental Site Investigation. Samples were collected from 0-6 inches below ground surface and 6 inches to 2 feet below ground surface from all boring locations. Soil samples were also collected from approximately 2 to 6 feet below ground surface from a portion of the locations. The samples were analyzed for TCL VOC's and SVOC's, and TAL metals plus cyanide using the USEPA Contract Laboratory Program 1988 Inorganic Analyses and 1991 Organic Analysis Statement of Work Routine Analytical Services. A summary of the soil results is presented in Table 6-1. The complete data package and corresponding validation reports are presented in Appendix H.

6.2.1 Soil Sampling Limitations

The FSP Addendum (USACE, 1998a) called for a minimum of two soil borings on each of the residential properties bordering or including the CDA. Two soil borings were not completed due to the landowner denying access. Problems with access to the remaining eighteen proposed locations arose due to heavy vegetation. Therefore, all of the soil borings had to be relocated to some extent, with some property parcels gaining additional soil borings while other property parcels lost one or all of the proposed soil borings. Offsets from the proposed soil boring locations ranged from approximately 25 to 130 feet. Soil samples were obtained from land parcels D, F, M, O, P and S. No soil samples were obtained from land parcels N, Q, R and T. The final soil boring locations are shown on Figure 2-2, along with the property parcels and their respective landowners at the time sampling was completed.

6.2.2 Data Qualifiers and Limitations

QC checks were performed routinely during data collection and analysis to verify that the data collected are of appropriate quality for the intended use and that the data quality objectives were met.

The soil analytical data were fully validated by USEPA using the National Functional Guidelines (NFG's) for Organic and Inorganic Data Review (EPA 540/R-94/012 and /013). Those items impacting the data usability are summarized here. The complete data reports, review, and validation results can be found in Appendix I.

There are general areas of data qualification that were necessary based on initial or continuing calibration and internal standard or surrogate recoveries. The qualification was primarily in the estimation of the affected results and are not discussed in detail here.

6.2.2.1 Data Qualifiers

The data was reviewed in the laboratory and qualifiers were applied as required by the Scope of Work. The data validation resulted in additional qualifiers, as needed, to support the data usability.

The following conventions have been applied and are included in the data summary tables.

- All data that are estimated, regardless of the concentration reported, have been qualified "J".
- The inorganic qualifier "B", used to represent estimated data, has been changed to "J" for use in the data tables and risk assessment to minimize the qualifiers used and avoid confusion.
- Qualifiers based on blank contamination: All organic and inorganic samples that contain an analyte that is also present in a equipment rinse blank or laboratory method blank, are qualified "B" unless the amount present is less than ten times the blank concentration for the common laboratory contaminants or five times the amount present in the blank for all other analytes. If the amount present in the sample is less than ten times the amount present in the blank for the common laboratory contaminants, or five times the amount present in the blank for any other analyte, the result is qualified "UB".

6.2.2.2 Data Limitations

No sample specific limitations were observed.

6.2.3 Soil Analytical Data

Methylene chloride and/or acetone were detected in soil samples at low concentrations at several locations (SB03, SB15, SB16, SB17, SB19, SB20). These detections have been attributed to artifacts of sample collection or lab contamination based on the results of the data validation. Carbon disulfide, 1,1-dichloroethane, benzene, ethylbenzene, and xylene were detected in the soil sample collected from 2 to 6 feet at boring location SB16. The concentrations reported ranged from 2 µg/kg to 14 µg/kg. No other volatile compounds were detected in any of the soil samples.

The semivolatile compounds detected in the site soils consist primarily of analytes from the phthalate and polynuclear aromatic hydrocarbon (PAH) groups. Phthalates are materials that provide flexibility in plastics. PAHs are trace constituents of petroleum and often detected where releases of gasoline, diesel fuel, jet fuel, heating oil, tar, and asphalt have occurred. The phthalates detected and the corresponding locations include di-n-butylphthalate (SB16, SB19) at 37-390 µg/kg, butylbenzylphthalate (SB16) at 60 µg/kg, diethylphthalate (SB16) at 64 µg/kg, bis(2-ethylhexyl)phthalate (SB05, SB06, SB07, SB09, SB10, SB12-14, SB16-17, SB19) at 39-30,000 µg/kg, and di-n-octylphthalate (SB10,SB19) at 56-120 µg/kg. PAHs were detected at least once in either the surface and/or subsurface soil from locations SB04, SB05, SB06, SB11, and SB13 though SB20. These include:

- naphthalene (SB14, SB15, SB16, SB18, SB20) 38-2,200 µg/kg;
- 2-methylnaphthalene (SB18, SB20) 48-100 µg/kg;
- acenaphthylene (SB15, SB18, SB19, SB20) 67-2,300 µg/kg;
- acenaphthene (SB11, SB14, SB18, SB20) 37- 890 µg/kg;
- fluorene (SB18, SB20) 44-2,500 µg/kg;
- anthracene (SB11, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 41-4,900 µg/kg;
- dibenz(a,h)anthracene (SB11, SB13, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 58-2,000 µg/kg;
- phenanthrene (SB05, SB11, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 37-18,000 µg/kg;
- benzo(g,h,i)perylene (SB04, SB05, SB06, SB11, SB13, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 38-7,100 µg/kg;
- fluoranthene (SB05, SB11, SB13, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 43-29,000 µg/kg;
- pyrene (SB05, SB11, SB13, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 44-21,000 µg/kg;
- benzo(a)anthracene (SB05, SB11, SB13, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 39-9,700 µg/kg;
- chrysene (SB05, SB11, SB13, SB15, SB16, SB17, SB18, SB19, SB20) 47-9,700 µg/kg;
- benzo(b)fluoranthene (SB05, SB11, SB13, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 38-9,700 µg/kg;

- benzo(k)fluoranthene(SB11, SB13, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 50-10,000 µg/kg;
- benzo(a)pyrene (SB05, SB11, SB13, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 53-11,000 µg/kg;
- dibenzofuran (SB11, SB20) 78-1500, carbazole (SB11, SB15, SB17, SB18, SB19, SB20) 37-1,500 µg/kg; and
- indeno(1,2,3-cd)pyrene (SB05, SB11, SB13, SB14, SB15, SB16, SB17, SB18, SB19, SB20) 41-6,400 µg/kg.

Other semivolatile compounds detected include 1,2-dichlorobenzene (SB16) at 98 µg/kg, and 4-methylphenol (SB20) at 50 µg/kg.

As shown in Table 6-1 each of the twenty-three TAL metals were detected at least once. Aluminum (1,360-8,860 mg/kg), arsenic (0.55-12.5 mg/kg), barium (7.8-444 mg/kg), calcium (361-85,900 mg/kg), chromium (3.3-25.1 mg/kg), copper (3.1-2,220 mg/kg), iron (1,330-26,000 mg/kg), lead (5.2-695 mg/kg), magnesium (333-22,600 mg/kg), manganese (14.8-1,410 mg/kg), and zinc (10-1,120 mg/kg) were detected in all samples at the range of concentrations listed. Antimony was detected in two samples at 9.2 and 13.1 mg/kg. Beryllium was detected in twenty-three of the samples at concentrations ranging form 0.1-0.9 mg/kg. Cobalt and sodium were detected in forty-one samples ranging in concentrations from 1.7-10.8 mg/kg and 16.8-525 mg/kg respectively. Mercury was detected in twenty-eight samples at concentrations ranging from 0.05 to 27.9 mg/kg. Nickel was detected at concentrations of 5.8-298 mg/kg in twenty-eight samples. Potassium was detected in thirty-four samples at concentration of 125-586 mg/kg. Selenium was detected in thirteen samples at concentrations of 0.1-1.6 mg/kg. Silver was detected at concentrations of 0.80-3.1 mg/kg in six samples. Thallium was detected in seven samples at concentrations of 0.09-0.5 mg/kg. Vanadium was detected in forty-four samples at concentrations of 3.7-18.0 mg/kg. Cyanide was detected in forty-three of the samples at low concentrations ranging from 0.05-4.9 mg/kg.

6.3 Restrictions and Recommendations on Data Use

The data met the data quality objectives for precision, accuracy, representativeness, comparability, and completeness and are adequate for its intended use. The most notable data restriction observed for the soil data is that the contract required quantitation limits exceed the risk based screening levels for some compounds. Because of this restriction, the presence or absence of these compounds below the screening criteria cannot always be definitively determined.

7.0 CONTAMINANT FATE AND TRANSPORT

This chapter provides a review of physical and chemical mechanisms that may affect the behavior of site contaminants discussed in Chapters 3, 4, 5 and 6, as well as the hydrogeologic characteristics discussed in Chapter 3. Migration pathways are identified, and the fate and migration of specific contaminants found in ground water, leachate, soil and soil gas are discussed.

7.1 Summary of Findings

Organic and inorganic contaminants that may pose a threat to human health and the environment have been identified in on-site soils, in soil gas measurements south and east of the site and in ground water on and off the Site. The contaminants used for discussion purposes detected in the different media are presented in Table 7-1. Selected properties of the organic chemicals that are migrating in ground water are summarized in Table 7-2. To understand how the contaminants move through the subsurface, a brief summary of geology and hydrology of the study area is provided. Following, this, a summary of historical trends of flow conditions and contaminants will be presented.

7.1.1 Geology and Hydrology

For a more complete discussion of fate and transport issues, a review of the site geology is presented. Little geologic investigation has been done since the Remedial Investigation (RI) completed by SEC Donohue, Inc. (Donohue) in 1992. The main sources of geology and hydrology of the site and the surrounding area are from the RI, the USGS studies and the USACE pre-design. The discussion of geology is divided into two sections. The first section describes the regional geology of Northern Indiana and Elkhart County. The second section describes the geology in the immediate area of the Site. The final section summarizes the hydrology of the study area.

7.1.1.1 Regional Geology

The regional geology of northern Indiana and Elkhart County consists of glacial outwash deposits of the Quaternary Period overlying shales from Devonian and Mississippian Periods (Figure 7-1). Structurally this area is considered part of the Michigan basin which dips to the northeast at a gradient of about 30 feet per mile. Quaternary Period deposits found in the region were predominately deposited during the Wisconsinan glaciation of the Pleistocene Epoch. As the glacial ice receded, the fast-flowing water deposited layers of sand and gravel, and the slower moving and standing water deposited silts and clays. The fast-flowing water deposits are known as valley train outwash deposits. The thickness of these deposits ranges from 85 to 500 feet in Elkhart County. A silt and clay layer, which separates the sands and gravels where present, has a maximum thickness of 80 feet and an average thickness of 20 feet. The bedrock topography was modified by continental glaciation.

The bedrock topography in Elkhart County varies from approximately 300 feet above mean sea level (famsl) to 600 famsl. The thickest portion of the outwash deposits occurs within a bedrock valley

trending north-south that underlies the western part of the landfill (Figure 7-2).

The pre-glacial units of the Paleozoic Era consist of the Ellsworth shales of Devonian and Mississippian Periods. The Ellsworth Shale consists of alternating beds of gray-green shale and brownish-black shale in the lower part, and grayish-green shale bearing light-greenish limestone or dolomite in the upper parts of the formation. The formation consists predominantly of greenish gray shale. The thickness of the Ellsworth ranges from 39 feet to 196 feet ((Indiana Department of Natural Resources, 1987).

7.1.1.2 Site Geology

The following discussion of the geology at the Site is based on interpretations and regional geological information from three USGS hydrogeological studies of the northwest portion of Elkhart County, Indiana (Imbrigiotta and Martin, 1981; Duwelius and Silcox, 1991; Arihood and Cohen, 1998), as well as the site specific studies completed by Donohue (Donohue, 1992) and the USACE (USACE, 1996) for the USEPA. The first USGS study covered the northwest portion of Elkhart county. This study area contained two areas of concern that involved ground-water contamination, one of which was the Site. During this study, 168 monitoring wells were completed over the entire northwestern portion of Elkhart County at depths ranging from 20 to 489 feet below ground surface. The thickness and areal extent of the unconsolidated Pleistocene deposits were determined from lithologic logs and from natural gamma radiation logs of 35 test borings. A quasi-three-dimensional ground-water-flow model was also completed to assist in the evaluation of ground-water resources for the City of Elkhart. Subsequent USGS studies did not include the installation of additional borings and/or monitoring wells in the area. The second USGS study involved the collection of water levels from 68 monitoring wells and water-quality information from 32 of those monitoring wells in the area of the Site (Duwelius and Silcox, 1991). The most recent USGS study was the completion of a ground-water-flow model updated with the information collected from studies completed since 1981 and limited streamflow data collected in late 1994 to early 1995 (Arihood and Cohen, 1998).

Donohue. completed eleven soil borings at depths ranging from 16 to 175 feet below ground surface. Eleven monitoring wells were installed during this investigation (Donohue, 1992). The USACE completed 13 borings and installed 13 monitoring wells in two phases (USACE, 1996, and this report). All USGS, Donohue and USACE well construction and geologic logs are provided in Appendices A, B and J.

The Elkhart County area is underlain by an extensive, thick outwash aquifer composed of sand and gravel. In some parts of the area, there is a silt and clay layer that may act as a semi-confining unit. This semi-confining layer, where present, divides the outwash aquifer into an upper unconfined aquifer and a lower semi-confined aquifer. The semi-confining layer in the vicinity of the is shown in Figure 7-3 (Imbrigiotta and Martin, 1981). The Paleozoic bedrock (principally shales) below the outwash aquifer generally act as confining units and generally are not considered a significant source of ground water. There are no records of any high-capacity wells in the bedrock near the Site (Indiana

Department of Natural Resources, 1987).

The aquifer materials, based on the geologic logs obtained are summarized in Table 3-2 of the RI (Donohue, 1992). In general, the upper portion of the aquifer (sometimes referred to as the upper aquifer) is well-graded sands and gravels to some poorly graded sands. The deeper portion of the outwash aquifer (lower aquifer) are poorly graded sands with some poorly graded gravels and some silty sands.

Total Organic Carbon (TOC) values obtained during the RI vary from 0.08 percent (Soil Boring B-02, 2-4 feet) to 8.9 percent (landfill soil sample), and are summarized on Table 7-3. The overall TOC values had a geometric mean of 0.68 percent. Those samples defined as possible aquifer materials; considered to be depths greater than 8 feet; are even lower, with a geometric mean of 0.6 percent. There were no TOC samples obtained for the lower aquifer.

7.1.1.3 Site Hydrology

To understand the site hydrogeologic conditions, the aquifer properties such as hydraulic conductivity and/or porosity must be evaluated. Furthermore, water levels, both present and historic, are used to determine ground-water-flow directions and changes in those directions over time. With this information, ground-water-flow velocities and possible contaminant pathways through the ground-water system can be identified.

7.1.1.3.1 Aquifer Properties

The saturated thickness of the outwash aquifer ranges from 40 feet in the vicinity of the North Main Street well field (located approximately 1.3 miles to the east-southeast of the Site), to more than 450 feet in the bedrock valley on the west side of the landfill. In both the upper and lower aquifers, the materials varied from sand to sand and gravel. The average hydraulic conductivities calculated from specific capacity tests for the sand is 80 feet/day and for the sand and gravel was 400 feet/day (Imbrigiotta and Martin, 1981). Based on 16 monitoring wells tested by single-well hydraulic conductivity tests (commonly referred to as slug tests) by Donohue (1992), a geometric mean was calculated at 24.3 feet/day for the horizontal hydraulic conductivity. Values range from 1.78 feet/day (WTE3) to 235 feet/day (WTF1). These values fall within hydraulic conductivity values for silty sand, clean sand, and gravel as described by site investigators. Wells screened in the upper aquifer, above the semi-confining clay layer found at an approximate elevation of 700 feet above mean sea level (famsl), have been described has having more gravel. The corresponding geometric mean of the aquifer tests in ten wells is 64.4 feet/day with a minimum of 15.5 feet/day (WT102A) and a maximum of 235 feet/day (WTF1). The wells screened in the lower aquifer, corresponding to below the sem-confining layer (elevation lower than 675 famsl) have more poorly graded sands, siltier sands and less gravel. The corresponding geometric mean of hydraulic conductivity based on six wells tested in this lower aquifer is 4.77 feet/day, with a maximum hydraulic conductivity calculated at 11.3 feet/day (WT101B). In the calibrated USGS ground-water flow model (Arihood and Cohen, 1998), both the

upper and lower aquifers used 170 feet/day. The field tests for hydraulic conductivity values indicate the possibility of a heterogeneity between the upper and lower portions of the study area, possibly due to the nature of the geologic deposits. The differences between the three methods to estimate hydraulic conductivity may be a function of the different scales of testing, which may indicate larger volumes of aquifer tested, which would result in higher values for the hydraulic conductivity. But in any case, the hydraulic conductivity is varied, depending on the aquifer materials present, predominately on the amount of gravel and presence of silts and other fines in the sands.

The vertical hydraulic conductivity of the silt and clay semi-confining unit is estimated at 0.07 ft/day, based on average hydraulic conductivities of silt and clay (Freeze and Cherry, 1979) and the calibrated USGS ground-water flow model (Arihood and Cohen, 1998). A specific yield of 0.15 for the unconfined aquifer and a storage coefficient of 0.0001 for the confined aquifer have been calculated (Arihood and Cohen, 1998).

Site-specific porosity measurements were not completed for this site. A porosity of 20 to 50 percent is a typical value for sand and gravel mixes (Fetter, 2001). For this site, an estimate of 30 percent is used because of the predominance of sand, along with occasional silt.

7.1.1.3.2 Water Levels and Flow Directions

Ground water levels have been collected from wells beginning in some wells in 1978 and continuing through 2000. However, since the completion of the RI, most of the water levels collected have been associated with sampling events, and therefore are not synoptic in nature. Also since the completion of the RI, several USGS monitoring wells off of the landfill property have been decommissioned or destroyed, including the F, I and K clusters, and the N and Q wells. The wells lost prevent a more regional evaluation and comparison of ground-water-flow conditions.

A regional contour map of the ground water flow in the unconfined aquifer in the vicinity of Site is presented in Figure 7-4. Ground water flow is generally south towards the St. Joseph River (Figure 7-4), which is a regional discharge for this area. A similar flow pattern for the aquifer under the semi-confining unit (when present) was found by the USGS (Duwelius and Silcox, 1991). This flow pattern is characteristic of a well-connected stream-aquifer system with a gaining stream. Vertical water level differences between aquifers are generally small in areas away from the St. Joseph River, but upward gradients can be found in areas near the river (Imbrigiotta and Martin, 1981). Water levels in the aquifer fluctuate from 2 to 5 ft/yr. Water levels are highest in late April and May, and lowest in September and October (Arihood and Cohen, 1998). Ground water pumpage in this aquifer is greatest in the City of Elkhart. The North Main Street well field has 15 production wells supplying approximately 4.4 million gallons per day, which constitutes approximately 53 percent of the total water pumped in the city (Arihood and Cohen, 1998).

According to the USGS study, ground water occurs in the study area at depths ranging from 8 to 17 feet below ground surface. The outwash aquifer is unconfined below the Site, and the silt and clay

confining layer is absent. The saturated thickness of the aquifer below the site in the vicinity of the bedrock valley is on average approximately 200 feet. However, the buried bedrock valley on the west side of the landfill has a saturated thickness as great as 450 feet by the USGS B and C well clusters.

The RI ground water flow interpretations at the Site include primarily the upper 200 feet (approximately) of the outwash aquifer. This is due to the limited depths of the investigative monitoring wells. Only one well (WTB1) was screened below the upper 200 feet of the outwash aquifer. In general, ground water flow found during the RI field program appears to be consistent with regional conditions and USGS investigation results (Donohue, 1992).

Ground water occurs between approximately 5 and 20 feet below the site at an elevation ranging from 752 to 759 famsl within the sand and gravel outwash deposits. The elevation of the bottom of the waste mass is estimated to range from 755 to 760 famsl. However, ground water fluctuations can occur across the site by as much as 6.5 feet. Three surface water bodies represent the surface expression of the water table at the site. No new information since the RI was collected on the interconnection between the surface water bodies and ground water. Donahue (1992) concluded that the ground water and surface water are in connection in what appears to be a flow-through-pattern, which is reportedly common for the types of geologic deposits found at the Site.

Ground water flow in both the upper and lower aquifers is generally to the south-southeast towards the St. Joseph River, which is a regional ground water discharge for this area (Imbrigiotta and Martin, 1981; Duwelius and Silcox, 1991; Donahue, 1992; Arihood and Cohen, 1998). Donahue (1992) reported that ground water flows in a more southerly direction under the western half of the site. These ground water flow directions were consistent with those found during the course of this study. The USGS average of horizontal ground water flow gradients across the study area was 1.5×10^{-3} ft/ft (Duwelius and Silcox, 1991). Also, Donahue (1992) reported that the average horizontal ground water flow gradient within the study area is approximately 1.6×10^{-3} ft/ft.

The vertical direction of ground water flow is complex, changing between well clusters and over time within a well cluster. Vertical flow gradients within the upper 200 feet of the outwash deposits include both upward and downward values. For example, during the RI, Donohue calculated the vertical flow gradients from the two well clusters located at the southeast (WT1O1A, WT1O1B, WT1O1C) and northwest (WT102A, WT102B, WT102C) corners in the site, all of which are screened in different sections of the upper and lower aquifers. During water levels collected in February 1991, the WT101 cluster had downward vertical gradients (Donahue, 1992). However for the water levels collected in November 1991 (Donahue, 1992) and April 2000 (Section 3.1), upward vertical gradients were noted. For the February and November 1991 dates, the WT102 cluster had upward vertical gradients. For the April 2000 measurement, the shallowest well pair (WT102A and WT102B) had a downward vertical gradient. On the other hand, the deeper well pair (WT102B and WT102C) had an upward vertical gradient.

When considering all well clusters and measurement events, downward vertical gradients ranged from 3.7×10^{-2} ft/ft to 3.5×10^{-4} ft/ft. Upward vertical gradients ranged from 2.1×10^{-4} ft/ft to 1.3×10^{-3} ft/ft. The USGS reported vertical gradients values ranging from 9.5×10^{-5} ft/ft to 7.7×10^{-2} ft/ft with an average value of 5.5×10^{-3} ft/ft (Duwelius and Silcox, 1991). In general, the vertical gradients are highly variable and will change with time. But the range and average of vertical gradients show higher probability of vertical flow when compared to the horizontal gradients observed, indicating the likelihood of a complex vertical movement of ground water, and therefore contaminants, from the landfill.

An upward vertical gradient of 7.3×10^{-4} ft/ft was estimated in USGS well cluster WTB between shallow well WTB2 and a very deep well WTBl during the RI and in this study, 1.75×10^{-4} ft/ft between intermediate well WTB3 and the very deep well WTB1. These vertical gradients indicate that the upward vertical gradients continue to persist from the bottom of the bedrock valley and confirm that the St. Joseph River is a regional discharge point for ground water.

Plots of water level trends for the WT101, WTB, WTE and WTM clusters are provided in Figures 7-5 through 7-8. These water level trends show that the wells screened at different zones within the study area, respond hydraulically similar. The USGS has been monitoring water levels continuously since the mid-1970's at several different locations in Elkhart County. One of these locations was WTE3 from March 1983 until September 1989, which is presented and discussed by the USGS (Duwelius and Silcox, 1991). Arihood and Cohen (1998) evaluate several monitoring locations for water level trends at several locations shown on Figure 7-2. The data is presented in Figure 7-9 which illustrates seasonal fluctuations in water levels, but that the overall trends show only slight differences over time. The well clusters monitored show similar trends for both shallow and deep wells

7.1.1.3.3 Ground Water Flow Velocity

The average linear ground water flow velocity is highly variable, depending on the hydraulic conductivity values used, and will likely vary with depth. Using the horizontal hydraulic conductivity values provided in Section 7.1.1.3.1, values range from 0.025 feet/day (9.3 feet/year) to 2.13 feet/day (779 feet/year). These values are based on an average horizontal hydraulic gradient of 1.6 x 10-3 ft/ft and a porosity of 0.30. Using a regionally derived hydraulic conductivity (Arihood and Cohen, 1998), the ground-water-flow velocity is approximated as 0.91 feet/day (331 feet/year).

Duwelius and Silcox (1991), using the rate of bromide movement through the aquifer, estimated the rate of bromide migration to be between 1.1 feet/day (401 feet/year) to 1.7 feet/day (620.5 feet/year) with an average rate being approximated at 1.2 feet/day (438 feet/year). Since bromide is considered a conservative tracer (little attenuation, or loss of mass), this rate of movement would be considered to closely approximate the rate of ground water flow. These values of bromide movement are within the range of the ground water flow velocities calculated by hydraulic testing, would therefore be expected to represent the maximum possible rates of other contaminants if present in ground water.

7.1.1.3.4 General Ground Water Quality Parameters

Based on the Donohue (1992) RI, the general water-quality of the aquifer is has median concentrations of 440 mg/L total dissolved solids; 286 mg/L hardness (as calcium carbonate); iron, 900 ug/L; nitrate (as nitrogen), 0.01 mg/L; and chloride, 10 mg/L.

Other general water-quality parameters collected include temperature, pH, specific electrical conductance (SEC), dissolved oxygen and oxidation/reduction potential (ORP). Not all of the parameters were collected during all sampling events, although the first three listed were generally collected. Table 7-4 presents the maximum, minimum and mean of the field parameters based on the historical data collected from each of the wells. Temperature is not presented because this parameter is more seasonally dependent, and not indicative of actual ground water conditions, unless taken down the well, which was not completed on this site. One limitation in presenting these parameters in this fashion, is that the parameter values may change because of historical trends. An example is provided in Figure 7-10 for well WTE3, which indicate the change in SEC is time dependent. This trend was seen in other wells such as WTE2, WTM1 and others. Therefore, the mean, maximum and minimum of SEC from the 1980's may be different in the 1990's, or even over smaller increments of time. Also, some temporal variation in some parameters may be due to changes in sampling procedures, equipment, personnel, etc. Another possible limitation is that ORP readings were not taken during most sampling events, so any interpretations of this data is somewhat limited. Dissolved oxygen readings were also questionable during some sampling events because high readings were sometimes encountered which may indicate aerobic ground water, whereas, for the same sampling event, ORP readings indicated anaerobic ground water. Dissolved oxygen is a parameter that can be easily biased by sampling methods and equipment.

Table 7-4 is colored red and blue, depending on whether the wells were screened in the upper or lower aquifers. Taking the means of the means for each well per the different aquifers, indicate little difference between the upper and lower aquifers for pH (7.32 vs. 7.59), ORP (15.4 mV vs. -15.1 mV), and dissolved oxygen (2.2 mg/L vs. 1.4 mg/L). However, there is a substantial difference between the SEC for the upper aquifer versus the lower aquifer (967 uS/cm vs. 700 uS/cm). This difference could be associated with the bromide plume; which may impact SEC readings; but may also be due to other effects such as road salt. In general, the water quality parameters indicate similarities in water type between the upper and lower aquifers, which further confirms the ground water flow conditions that the two units are in hydraulic connection and that mixing of water types is occurring.

7.2 Summary of Physical/Chemical/Biological Attenuation Mechanisms

The fate and migration of organic and inorganic contaminants in the subsurface environment can be affected by a number of chemical and physical attenuation mechanisms. These mechanisms may cause a contaminant to remain in solution, precipitate out of solution, be adsorbed to a surface, and/or transform or degrade into another compound. The following discussion summarizes each of the mechanisms involved.

7.2.1 Physical Processes

Physical processes are the predominate mechanism by which dissolved contaminants are moved through ground water. These mechanisms include advection, dispersion and diffusion, which are defined in the next three sections.

7.2.1.1 Advection

Advection is the movement of mass (such as contaminants) by the flow of water in which the mass is dissolved. Advection is the main process by which contaminants migrate through aquifer materials. If the movement of a contaminant is not retarded through other physical/chemical processes, the rate of contaminant migration is equal to the rate of ground-water flow. This process is directly dependent on the ground-water flow velocity. On this site, advection rates would be greatest along zones of high permeability, such as the cleaner sands and gravels in the aquifer. Therefore, in the upper aquifer and in most zones in the lower aquifer, advection processes would predominate in the movement of contaminants through ground water.

7.2.1.2 Mechanical Dispersion

Mechanical dispersion is fluid mixing that has dissolved mass with fluid that has a different composition. A non-reactive contaminant introduced into ground water or surface water will decrease in concentration as it is transported away from the source. This mechanical dispersion of a contaminant is independent of other chemical mechanisms affecting concentrations over distance. This process produces some spreading of contaminants in the horizontal and vertical directions. The extent of this spreading is dependent on ground-water-flow velocities and the aquifer properties. In general, aquifers with lower flow velocities will have more horizontal and vertical dispersion, resulting in a wider plume. In those aquifers with higher flow velocities such as those found in the upper and lower aquifers, the plumes would tend to be longer, but narrow. All contaminants are affected to some degree by dispersion. For this site, those areas which have lower ground-water flow velocities would have higher lateral dispersion.

7.2.1.3 Diffusion

Mass in water will move from greater concentrations to lower concentrations because of the concentration difference. In very low permeability materials, and/or in areas of very slow ground-water-flow velocities, the rate at which chemicals are physically moved by advection is very slow. However, chemicals may move due to diffusion under these circumstances through these geologic materials. The driving force is the concentration gradient between the zones which have high concentrations of contaminants, to those zones which have no, or low concentrations of contaminants. On this site, the diffusion rates would be expected to be substantially lower than the advection and mechanical dispersion rates in the upper and lower aquifers. The low-permeability materials within the silt and clay layer that separates the upper and lower aquifers may be the only place where

diffusion may be expected to be a significant contaminant transport mechanism. Also, the diffusion mechanism may be present into the isolated silt and clay seams, as well as, into the bedrock.

7.2.2 Chemical/Biological Processes

Several chemical and biological processes may retard the movement or transform the contaminants as they are transported through ground water. The predominant processes that may occur include sorption, biodegradation, oxidation/reduction, precipitation/dissolution, volatilization and hydrolysis.

7.2.2.1 Sorption

Contaminants may be adsorbed or desorbed by organic matter, soil and other materials, thereby reducing the rate of migration. The amount of a contaminant that will be adsorbed is a function of its' chemical composition, the geological matrix and the hydrogeochemical environment. A higher degree of solubility in water (Table 7-1) generally indicates that the compound will not sorb as much as a compound with a lower solubility. Thus, compounds which are completely miscible in water do not sorb readily onto aquifer materials. Strongly sorbed contaminants are relatively immobile and tend not to leach or migrate.

7.2.2.1.1 Effects of Chemical Composition on Sorption

Inorganic and organic compounds dissolved in aqueous solutions may adsorb onto solid phases. The amount of an contaminant adsorbed by soil mineral and organic matter is a function of the compound specific van der Waals forces, charge transfer, ion exchange, and hydrophobic bonding. Inorganic compounds may have multiple valence states, each exhibiting different adsorption behavior determined by the solution's redox potential (Eh), as indicated by the field readings of oxidation/reduction potential (ORP)). For example, chromium is stable, and relatively immobile in the chromium (III) state in reducing and low pH conditions, while chromium (VI) is more stable in strongly oxidizing conditions with higher pH conditions.

7.2.2.1.2 Effects of Geologic Matrix on Chemical Sorption

Geological matrix components, such as hydrous metal oxides (oxides of iron, manganese), amorphous aluminosilicates, layer lattice silicates (clays), and organic matter, all provide adsorptive surfaces. These surfaces adsorb contaminants through a pH-dependent charge. These characteristics are measured as total organic carbon (TOC) and cation exchange capacity (CEC). Soils high in silt and clay provide more surface area and adsorption sites than a sandy soil, as does increased organic matter in the aquifer matrix. Organic compounds have a strong affinity for organic matter in soils (as shown by organic carbon/water partition coefficient (K_{ow}) values for SVOC's, etc.) and some metals (such as mercury and lead). Clays present in the soils may provide adsorptive surfaces. Soil samples collected for TOC values adjacent to the landfill and within the aquifer are low (indicated by the geometric means of 0.68 and 0.60 percent respectively) and indicate little sorption onto organic matter

(Weidemeier et al., 1999). For this site, no CEC measurements were completed, so the possible sorption of metals onto clay surfaces cannot be calculated. However, except for the clay/silt semi-confining unit and a few silty sands, little significant clays appear to be present. Therefore, sorption does not appear to be a significant retardation factor for any of the contaminants in their movement through aquifer materials.

7.2.2.1.3 Effects of Hydrogeochemical Environment on Sorption

Hydrogeochemical conditions affect how each chemical contaminant reacts. Adsorption will vary depending on pH and redox conditions (Oxidation/Reduction Conditions), and on competing ion species present. This is particularly true of inorganic constituents. Decreasing ground water pH generally increases positive charge and favors anion retention, while increasing pH favors cation adsorption. Uncomplexed ions tend to be preferentially adsorbed over complexed ions. On this site the means of the pH is between 5.77 to 8.37 (Table 7-4). Most of the pH means are generally in the 6.7 to 7.8 range, which is essentially neutral water. A low pH well (WT111A) may indicate possible acidic contributions to ground water in that vicinity. A high pH well (WT104A) is not consistent with other, upgradient wells.

Changing redox conditions (indicated by ORP measurements in the field) can also change the oxidation state at which an ion may exist, which effects the mobility of that ion. For example, chromium, which has been found at the site, can commonly occur as either trivalent (chromium III) or hexavalent (chromium VI). With increasing reducing conditions, chromium will tend to occur as the more stable forms (trivalent) and not be as mobile. With oxidizing conditions, the chromium may be mobilized in the more toxic form of hexavalent chromium. The Eh readings (as indicated by the ORP field parameter) on the site vary from positive to negative values, depending on the location of the well in the aquifer.

7.2.2.2 Biodegradation

Biodegradation may be an important transformation mechanism for organic constituents under proper conditions. The mechanism may result in partial or complete reduction of contaminant concentrations, and the production of microbial cells, water, and carbon dioxide. Generally, the contaminant is transformed in the presence of an electron acceptor: oxygen in aerobic conditions, and nitrogen, sulfate, or carbon dioxide in anaerobic environments. The rate at which biodegradation takes place depends on many factors, including availability of nutrients (a carbon source, phosphorus, etc.), physical factors of the site conditions (such as pH, temperature, permeability, etc.), and types and concentrations of contaminants. Evidence of active biodegradation is present given the high concentrations in landfill leachate (Donohue, 1992) and the much lower concentrations detected in ground water, even though particular contaminants should be mobile (such as acetone and trichloroethylene).

7.2.2.3 Oxidation/Reduction

Ground-water systems, through hydrochemical and biochemical reactions, tend towards oxygen depletion and reducing conditions. This trend is counteracted by oxidation of organic matter catalyzed by microorganisms. The general decrease in dissolved oxygen produces H+ ions. This decrease in pH is often counteracted by the reaction of the H+ with various minerals. When all dissolved oxygen (DO) is consumed (DO generally less than 0.05 mg/L), and other oxidizing agents are also consumed, the environment may become so strongly reducing that organic compounds may undergo anaerobic degradation. This may also be indicated by ORP readings that are 100 or less mV readings. For this to occur, the microorganisms must have sufficient consumable material (organic matter), nutrients (nitrogen, sulfur, phosphorus, some metals), and climatic stability (temperature).

In ground-water systems, pH and redox are interdependent. Many redox reactions proceed at a slow rate, and may be irreversible. For example, the stability of iron solid and solution species is strongly affected by redox potential. Iron (II) species would be expected to be more stable under reducing conditions than the iron (III) species.

7.2.2.4 Precipitation/Dissolution

The solubility of metal species present in the aquifer matrix controls precipitation of metal contaminants in ground water. The thermodynamic behavior of various species may be used to predict the most stable phase that will form in the environment. The evidence for the existence of solubility-controlling solid phases is often indirect, such as comparison of ion activity products to solubility products. Hydroxide and carbonate solids, stable at neutral to high pH values, often control precipitation rates. For example, precipitation of iron oxides, hydroxides, and carbonates control iron (II) concentrations in ground water, as a function of pH and redox potential.

7.2.2.5 Volatilization

Loss of organic contaminants from the site through volatilization is dependent on site factors; including soil porosity, moisture content, nature of the land surface (whether there are buildings, asphalt, etc.) and climatic conditions such as temperature and wind speed. Volatilization is also dependent on contaminant-specific properties such as Henry's Law Constant and vapor pressure. The higher the Henry's Law Constant and/or the vapor pressure, the more volatile the compound. The process involves desorption of the contaminant from the soil into the soil water, diffusion through the water, interphase mass transfer between the water and air, and diffusion out of the soil pores into the ambient air. In addition, volatilization is an important mechanism for contaminants which enter the surface water.

A compound present on the site, such as toluene may potentially volatilize into the soil vapor phase and be released into the atmosphere, at a rate determined by the soil porosity, tortuosity of the soil pathway, effective depth of the soil cover, and vegetation present on the surface. Volatilization

appears to be an important mechanism for this site given the high soil gas readings currently detected (Section 5.1.2) as well as historically in on-site landfill detections (Donohue, 1992). In many samples, the detected soil gas compounds are different than many of the ground-water samples, potentially indicating two different migration pathways.

7.2.2.6 Hydrolysis

Hydrolysis reactions occur between water and an ionic species in solution. Salts of weak acids and bases hydrolyze and may affect overall attenuation of various contaminants. Hydrolysis rates are pH dependent and reactions may be catalyzed by acids, bases and specific metals. Hydrolysis may affect concentrations of chlorinated amides, esters, and other similar compounds and may be an important attenuation process at the leachate/ground-water mixing zone where catalysts may be present.

7.3 Potential Migration Pathways

Several potential migration pathways are present for all contaminants to migrate from the landfill to off-site locations. The primary pathways for off-site migration that were investigated were ground-water and soil-gas. The previously completed Remedial Investigation characterized the potential pathway from the soils and landfill cover by direct contact and wind-blown migration.

7.3.1 Ground Water

Ground water provides the primary pathway for contaminant migration from the landfill. Some contaminates are leached directly from the waste material that is buried into the zone of saturation (i.e. below the water table). Leachate from the landfill adds additional constituents into ground water through percolation from the unsaturated zone where additional waste is buried, contributing both organic and inorganic contaminants. The fate and migration of these contaminants is dependent on the interrelationship between site-specific geological and chemical conditions, and the physical and chemical properties of the contaminant. Physical and chemical mechanisms that may affect the fate of organic compounds include sorption (very limited), and biodegradation. Few physical mechanisms are available to retard migration of the inorganics.

7.3.2 Unsaturated Zone (Soil Gas)

Vapors composed of volatile organics are an additional pathway for contaminant migration from the landfill. The fate and migration of these contaminants is dependent on the geologic conditions and the chemical properties of the contaminants. This pathway, based on the distribution of contaminants, is likely independent of the ground-water pathway.

7.4 Analytical Trend Analysis

To evaluate the potential transport and attenuation mechanisms of the contaminants emanating from the Site, a temporal analysis of contaminant levels was made. Unfortunately, not all wells were sampled during all water quality sampling rounds, for all analytical parameters. Also, very few monitoring wells have existed throughout the course of the many investigations completed at this site. However, several of the USGS wells have been sampled for two decades for bromide, a conservative tracer and a contaminant associated with the landfill. Therefore, for discussion purposes, bromide trends will first be presented and analyzed.

A well nest closest to the landfill is the WTM cluster. Bromide levels for these wells are presented in Figures 7-11 and 7-12. For the upper aquifer (WTM2), the bromide levels remained essentially the same from 1980 until the last sampling in 1992. However, the well screened in the lower aquifer (WTM1) showed almost a seven-fold decrease from 1979 until the last sampling in 1992. These trends would indicate a continual source or recharge into ground water, but a gradual decrease of levels in the lower aquifer.

The well nest downgradient to the WTM cluster is the WTE cluster. Bromide levels are presented from these wells in Figures 7-13 through 7-15. Data from the water table well (WTE2), screened in the upper aquifer, indicate variable levels of bromide, but no discernable trend. Data from the middle well (WTE1), also screened above the semi-confining unit in the upper aquifer, indicate a generally decreasing trend to the bromide from 1980 until 2000. Data from the deeper well (WTE3), screened in the lower aquifer, indicate no trend until the 1990 sampling event, and has shown a decreasing trend since that time. An interesting comparison between this Figure 7-15 (bromide) and Figure 7-10 (SEC) indicate parallel trends, showing the correlation between bromide and SEC.

Cursory reviews of the bromide data for the wells WT105A (4 sampling events) and WT106A (6 sampling events), which are both shallow upper aquifer wells downgradient of the WTE cluster show similar non-discernable trends for bromide. The WT101B (98 feet deep) and WT101C (165 feet deep) wells also show non-discernable trends for bromide in the lower aquifer, although these two wells have each been sampled three times for bromide.

Possible conclusions are that the bromide source, although lower than past levels, is still actively recharging ground water. However, the vertical migration of bromide may be decreasing at some points in the aquifer.

An attempt was made to evaluate the trends of organic contaminant levels, but no discernable pattern was found. For instance, the USGS detected 55 µg/L of TCE in WTM1 in 1979 and is screened at approximately 103 feet deep, which is in the lower aquifer. The well was not sampled again for VOC's until the RI in 1990. However, TCE was not detected again in that well. Similar one-time detections of organic contaminants were found in other wells. When compared to the bromide trends, the changes in organic contaminant levels is much more sudden, indicating other potential transport

and/or attenuation mechanisms are present than those mechanisms impacting the movement of the conservative ion, bromide.

For some inorganic parameters, trend analysis indicate patterns consistent with bromide trends. For the USGS well, WTE3, iron and sodium are plotted in Figures 7-16 and 7-17. For both parameters, a general trend of increasing levels until 1992 is observed, with lower levels found in the 2000 sampling event. The decrease of these parameters roughly corresponds to the decrease of the bromide concentrations. One limitation in this observation, is the paucity of the data. The trend for both parameters is based on 7 data points, and only two of them in the last 10 years. However, other wells with other parameters show similar trends, increasing the likelihood these are real trends.

7.5 Transport and Attenuation of Contaminants

Leachate and soil samples, which have been used to characterize the sources in the landfill by Donohue (1992) indicate the presence of a large number and type of contaminants (Table 7-1). For the most part, these contaminants range from volatile to non-volatile, mobile to non-mobile. However, the likelihood that all possible contaminants that may be detected in the samples obtained by Donohue, must be considered somewhat remote because of the few number of leachate samples collected, the variability of results between the samples collected, and the number and type of contaminants disposed at the site.

As discussed previously, the two migration pathways evaluated during this study are the soil gas and ground water from the landfill. The soil gas investigations detected a large number of volatile organic compounds (Table 7-1). The lowest vapor pressure of the contaminants detected in soil gas was for the xylenes at 6.6-8.8 mm Hg (Table 7-2). The lowest compound with the lowest Henry's Law Constant was 0.0053 atm-m^3/mol for xylenes. Several of the other compounds detected in the soils and/or leachate, which were not detected in the soil gas, have lower vapor pressures or Henry's Law Constants.

Another migration pathway off of the landfill is via ground water. The contaminants detected in ground water tend to be many of the same ones detected in the soil gas, mainly volatile, although metals have also been detected. Some SVOC's (butylbenzylphthlate,diethyl phthalate, 4-methyl-2-pentanone) have also been detected in ground water, although at low levels.

One possible migration mechanism is between ground water and soil gas. However, the general lack of contaminants at the water table surface (indicated by the shallowest wells on site), except very close to the site, indicates this mechanism is fairly insignificant. The higher levels of contaminants, when present in ground water, is generally in the deeper wells as you move further from the site.

The vertical migration of contaminants from the site in ground water is not well defined at this time. Since some of the residential wells east of the landfill have concentrations of contaminants at or higher than concentrations found in monitoring wells, the vertical distribution of these contaminants is

uncertain. Very limited vertical profiling was completed during this investigation with a Geoprobe, and indicated the potential for preferential zones of migration that are currently undefined. The deepest the Geoprobe tested was 60 feet and that some residential wells are reported to be deeper than that. The existing data, primarily based on the bromide distribution, indicates significant vertical migration of contaminants from the site. Optimally, vertically-placed monitoring wells may indicate greater concentrations of contaminants than currently installed wells. If the addition of the total screened portions in any specific cluster of wells is summed and compared to the total aquifer thickness at that location, the result suggests that less than 15 percent of the aquifer thickness has been evaluated in the locations sampled at the maximum well coverage.

The probable contaminant migration scenario is that as the contaminants move vertically from the landfill, the contaminants partition between the air and water phase, based on their chemical properties. Those contaminants that are soluble will move in the water, those that are volatile move in the soil gas, those that are both, move in both phases. The remainder of the contaminants that are relatively non-volatile and insoluble remain close to the site. This probable migration of the contaminants is via two independent pathways.

The attenuation mechanisms vary based on the contaminants. A non-reactive contaminant such as bromide has only advection, dispersion and dilution as the major attenuation mechanisms. All of the contaminants will have advection, dispersion and dilution effects. For many of the metals, the likely additional attenuation mechanism is precipitation/dissolution and oxidation/reduction with some sorption. For the organic compounds, sorption may be limited. Some biodegradation may be occurring, but most likely confined to within and in the immediate vicinity of the landfill. This conclusion is supported by the apparent rapid disappearance of organics between the soils/leachate samples and the ground water wells closest to the site. Volatilization losses through the landfill cover and movement of soil gas off-site may also account for the loss of volatiles. What sorption is present, is most likely within the landfill materials, as indicated by the non-detections of the low mobility, hydrophobic compounds; indicated by the low solubility numbers in Table 7-2.

To illustrate how the potential contaminants may have moved through ground water, a review of the movement of the bromide plume through the ground water system at the Site is presented. The bromide trends indicate that past concentrations of contaminants may have been greater than is currently observed. This is clearly illustrated in Figure 7-18 by how the bromide plume has changed over time. Three periods of data collection are presented in Figure 7-18; November/December 1980, August 1988 and April/May 2000. Approximately 10 years separates each of the sampling events, which allows for sufficient time between sampling events to pass for illustrative purposes. The first two dates of data collection were presented in the 1991 USGS Report (Duwelius and Silcox, 1991). The last sampling date presented is the last round of extensive sampling completed on the site. Limitations on the use of this data is that very few wells have been sampled for all of these sampling events. Monitoring wells WTE1, WTE3, WTG1 and WTG3 have been the only wells sampled for each of these events.

The 1980 data indicate extensive bromide plumes in both the shallow and deep portions of the upper aquifer, and in the lower aquifer. The highest concentrations are centered around the WTE and WTM clusters of monitoring wells on the southeast portion of the landfill. The highest bromide concentration detected from all wells was 3.8 mg/L in WTM1, which is in the lower aquifer. This was also where the USGS detected TCE in 1979 at 55 µg/L.

The 1988 data indicate a high value of bromide at WTM2 in the shallow well in the upper aquifer, but generally lower values of bromide in the rest of the shallow wells in the upper aquifer. The deeper wells in the upper aquifer show the bromide plume to have migrated further south, centered on the WTJ cluster. One caution with this data interpretation is that there is not a deeper well in the shallow aquifer at the WTM cluster and that the main part of the plume could be between the WTI and WTJ well clusters, as these two clusters approximately 0.75 miles apart. Data from the lower aquifer indicate little change from 1980. The highest concentration of bromide was found in WTE3 in the lower aquifer.

The 2000 data indicate generally lower concentrations of the bromide in all three layers presented. However, one caution that should be kept in mind is that the WTM cluster was not available for sampling (having been removed by the USACE in 1996). The WTE cluster has shown significant decreases of bromide with time. However, the downgradient clusters (WTI and WTJ clusters) were not sampled as a part of the 2000 sampling event. Therefore, the extent or lateral migration of the bromide plume downgradient was not determined. The WTI cluster had apparently been destroyed in the late 1990's and was unavailable for sampling. WT116A, a new shallow well in the upper aquifer, had the highest concentration of bromide at 2.4 mg/L. This well is not far from the former WTM cluster location.

These trends indicated in Figure 7-18 support the analytical trends discussed in Section 7.4 and presented in Figures 7-11 through 7-15. Therefore, similar maps could be prepared as shown in Figure 7-18 for other contaminants found in ground water. For the organic compounds, the inconsistent detections may make this more difficult. For the inorganic compounds, and other parameters, such as SEC, this would be easier than the organics.

The elevated bromide detected in ground water, supports the conclusion that the landfill is still contributing to ground water quality degradation, as indicated by the trends between WTM2/WT116A. Furthermore, this trend would be expected to continue because of the lack of source removal or control. In addition, if a conservative tracer, such as bromide, is still present in shallow ground water by the landfill at concentrations that are not much lower than those found 20 years ago, then the possibility of other contaminants that are not as mobile entering the ground water flow system is likely. This confirms the continued detections of organics and other contaminants that have been detected over time, and would likely continue.

8.0 OVER-ALL CONCEPTUAL SITE MODEL

The Conceptual Site Model (CSM) is intended to aid in understanding and describing the site and to present assumptions regarding:

- Suspected sources and types of contaminants present,
- Contaminant release and transport mechanisms,
- Affected media,
- Exposure pathways, and
- Potential receptors that could contact site-related contaminants in affected media under current and future land use scenarios.

Principle elements of the CSM for the CDA and downgradient ground water are reviewed below.

8.1 Sources, Release Mechanisms, and Affected Media

The Himco Dump Site encompasses a closed landfill which operated from approximately 1960 to 1976 at a location adjacent to County Road 10 and John Weaver Parkway (Nappanee Street Extension) in the City of Elkhart, Elkhart County, Indiana (Figures 1-1 and 1-2). The Himco Dump Site covers approximately 100 acres and is bounded on the north by a woodlands, farm fields, and an abandoned gravel pit which is now a pond; on the south by County Road 10 and private residences; on the east by John Weaver Parkway and private residences; and on the west by two ponds and fields. Of the approximate 100 acre site, about 58 acres were used for a landfill disposal area.

About two-thirds of the waste in the landfill is reportedly calcium sulfate from Miles Laboratories. As much as 360 tons/day were dumped over an unspecified time period. Other wastes accepted at the landfill included demolition/construction debris, household refuse, and industrial and hospital wastes. The landfill had no borrow source, but obtained sandy soil for daily cover from an abandoned gravel pit to the north, ponded areas to the west, and essentially anywhere around the perimeter of the site where sand was available. In 1976, the landfill was closed and covered. The cover consisted of approximately one foot of sand overlying a calcium sulfate layer.

The CDA bordering the southern perimeter of the landfill consists of construction rubble mixed with non-native soil. Numerous small piles of rubble, concrete, asphalt, and metal debris are scattered throughout the area; however, the calcium sulfate layer found at the landfill is not present in the CDA. The CDA is approximately 4 acres in size and is subdivided into seven residential and one commercial property parcels (Figure 1-2). The residential parcels are currently occupied. The existing homes on these residential parcels are connected to a municipal water supply; however, some

of the homes also have operable water wells. The commercial property is not currently occupied or being used for any purpose.

Contaminants identified in Himco Dump Site soils and/or ground water in previous investigations include pesticides, PCB's, VOC's, SVOC's, and metals. The CSM (Figure 8-1), specifically developed for the CDA south of the landfill and ground water migrating from both the landfill and CDA, considers receptor exposure pathways associated with all site environmental media known or inferred to be affected by site-related chemicals, as determined during previous investigations. Potentially affected media includes soils, ground water, and air.

Chemical release mechanisms are dependent on the nature of the contaminants and the media in which they occur. Common contaminant release mechanisms include direct discharge, volatilization, generation of fugitive dust, leaching, dissolution into and migration with ground water, and surface runoff. Contaminants could have been directly discharged into environmental media through surface releases and leakage of wastes from the landfill into subsurface media. Partitioning of contaminants from one phase to another is another type of release/fate mechanism. Soluble chemicals can be leached from soils by infiltrating precipitation or contact with ground water, or may dissolve from free-phase products into underlying ground water. Volatile organic compounds can volatilize into soil gas or the atmosphere. Surface contamination may be spread by overland runoff or precipitation. Non-volatile chemicals sorbed to surface soils may become entrained in the air as particulates in fugitive dust and then redeposited back into the outdoor environment or tracked indoors.

Specific site conditions influence chemical release mechanisms and contaminant migration pathways. For example, surface topography, hydrology, vegetation, and impermeable surfaces such as pavement can affect surface runoff, leaching, and the generation and disposition of fugitive dust. For example, paved surfaces often result in the accumulation of contaminants above the ground in more accessible areas, such as in streets, curbs and driveways. These contaminants are then available for re-entrainment in dust, track-in to indoor areas and for direct contact. Pavement also prevents escape of soil gas volatiles to the ambient air, thereby aiding in the build-up of higher concentrations of contaminants in the soil gas. Climate, soil type, and depth to ground water also affect contaminant leaching. Hydrogeological characteristics and ground water chemistry affect the vertical and horizontal extent and rate of dissolved contaminant plume migration. As environmental media at a site become contaminated, they may serve as secondary sources of contamination by acting as reservoirs of chemicals that are slowly released into other media. Detailed discussions of the groundwater flow and transport and attenuation of contaminants are described in Sections 3.1 and 7.5, respectively.

The following sections and the Conceptual Site Model (Figure 8-1) utilized the above transport mechanisms in determining the site-specific receptors that may be exposed to contaminants in the environmental media.

8.2 Current and Future Land Use Scenarios

Currently, there are residences near the Himco Dump Site to the east, southeast and south, and industrial and commercial properties southeast of the site (Figure 2-1). Given the variability in ground water flow directions as described in Sections 3.1 and 7.1.1.3.2 of this report, and the variability in wind direction as described in the baseline risk assessment prepared for the Himco Dump Site (Donohue, 1992; Appendix E1), statements regarding the locations of residences from the Himco Dump Site relative to prevailing wind directions and ground water flow are generalities. Residences located east of the Himco Dump Site are generally downwind and potentially side- to downgradient with respect to ground water flow. Residences located to the southeast of the Himco Dump Site are occasionally downwind and consistently downgradient with respect to ground water flow. Residences located to the south of the Himco Dump Site are generally upwind and consistently downgradient with respect to ground water flow.

Several hypothetical future land uses are possible for the Himco Dump Site, but may not be technically and/or financially reasonable. Possible future scenarios include development of residences or commercial/industrial properties on site. The composition of the natural soils in combination with the shallow water table and fill material would make construction on the site difficult and potentially costly. Construction along the perimeter of the site (not on the landfill) would be more feasible. Other hypothetical future land uses include recreational or agricultural.

8.3 Identification of Populations of Concern

For the purposes of the risk assessment which follows in this report, receptors are defined as nearby residents that potentially could be exposed to site-related contaminants in environmental media. Based on current and expected future land uses at or near the Himco Dump Site/CDA, receptors include residents to the south, where the CDA extends onto the residential properties, construction workers to the south conducting work on the residential properties, and residents to the east and southeast (collectively referred to as the east hereafter) of the Himco Dump Site/CDA using private wells for drinking water. Based on discussions of ground water flow [flow mainly to the south and southeast (Section 3.1)], residential properties located to the south and east are most likely to be receptors of ground water at the Himco Dump Site. The risks to the receptors south of the site will be discussed in Chapter 9. The risks to the receptors east of the site will be discussed in Chapter 10.

8.3.1 Himco Dump Site/CDA Off-Site Residential Area

Current and future off-site residents are defined as individuals that reside near the Himco CDA. The CDA extends south from the landfill boundary and onto property (off-site) owned by adjacent landowners. Current and future off-site residents were assumed to be exposed to surface soils, and mixed soils (gardening) in the land parcel areas (Figure 2-1), and exposed to ground water at well locations WT116A and WT119A. Monitoring well WT116A was chosen as this well is located within the CDA, and monitoring well WT119A was chosen as this well is located immediately

downgradient of both the CDA and WT116A. These monitoring wells were also chosen because they represent the most contaminated area of the ground water plume emanating from the landfill and CDA both horizontally and vertically, and have the most potential to affect the receptors of concern. Monitoring wells WT111A, WT116B, and WT118B are located either within or downgradient of the landfill/CDA; however, contaminant levels detected in ground water samples from these wells are significantly less than those found in monitoring wells WT116A and WT119A. Monitoring wells not immediately downgradient of the CDA were not considered for use in this Himco Dump Site/CDA Off-Site Residential Area portion of the risk assessment which follows in this report.

Current and future off-site residents to the south of the site were assumed to be exposed to surface soils, and mixed soils (down to 2 feet bgs) in the CDA via ingestion, and dermal contact. In addition, all residents were assumed to be exposed to ground water via ingestion (drinking water), dermal contact, and inhalation of volatiles while performing household activities, and showering or bathing.

Although soil gas data were collected in the supplemental investigation (and discussed in Chapter 5), the objectives were to determine if soil gas was indeed migrating from the landfill boundary, and to aid in evaluating remedies proposed for the site. Because of the sampling locations for these data, the data are not suitable for modeling volatile gas concentrations in ambient (outdoor) air or in indoor air, and therefore were not used quantitatively. However, a qualitative discussion of these results is presented. Figures 5-1 through 5-4 present the contoured concentration data for the compound classes BTEX (benzene, toluene, ethyl benzene and xylene), chlorinated ethenes, chlorinated ethanes and vinyl chloride. All of the listed compound classes were found along the entire length of the southern off-site area of the landfill where sampling was performed.

A current and future off-site worker is defined as an individual who works in the CDA near the Himco Dump Site, and is involved in resident home improvement construction projects. Intrusive workers (i.e., construction workers) were assumed to be exposed to mixed soils (0 to 6 feet bgs) via ingestion of soil, dermal contact with soil, and inhalation of particulates.

8.3.2 Eastern Off-Site Residential Area

For the purposes of the Eastern Off-Site Residential Assessment, receptors are defined as nearby residents that potentially could be exposed to site-related contaminants in ground water. The objective was to conduct a human health risk evaluation that more reasonably addresses the exposures to ground water by those residents residing to the east (which includes the southeast) of the Himco Dump Site.

The following monitoring wells and direct-push points were selected in order to quantitatively determine exposure to receptors drawing water from ground water: WT101A, WT114A, WT114B, GP16, GP101 and GP114. These monitoring wells, and direct-push sampling points located along the eastern perimeter of the landfill, were chosen as they are located immediately downgradient of the landfill. Given the available data set, they represent the most contaminated area, both horizontally

and vertically, of the ground water plume migrating from the landfill to the east and southeast. As indicated in Chapter 7, the vertical migration of contaminants in ground water from the Himco Dump Site is not well defined. Very limited vertical profiling, completed during the 2000 Supplemental Site Investigation using direct-push methods, indicates the potential for preferential zones of migration. These zones are not well defined and the vertical distribution of contaminants is uncertain. Some of the residential wells east of the landfill have concentrations of contaminants at, or higher than, concentrations found in monitoring wells. Thirteen residential water wells located to the east of the landfill were sampled during the 2000 Supplemental Site Investigation. Water well construction details were found for only 5 of these wells. Screened intervals for these residential wells ranged from 45-50 feet, 60-65 feet, and 74-78 feet below ground surface. Monitoring wells WT101A and WT114A are screened across the water table, and WT114B is screened from 60.3-65.3 feet below ground surface. None of these monitoring wells are necessarily screened at the correct depth to optimally capture the greatest vertical concentrations of contaminants. Therefore, ground water analytical data from direct-push sampling points were also included. Analytical data collected from private wells used by the residents east of the Himco Dump Site will be discussed qualitatively to address any potential risk not quantified in the risk assessment.

Although soil gas data were collected in the supplemental investigation, because of the sampling locations for these data, the data are not suitable for modeling volatile gas concentrations in ambient (outdoor) air or in indoor air, and therefore were not used quantitatively. However, a qualitative discussion of these results is presented. Figures 5-5 through 5-7 present the contoured concentration data for the compound classes BTEX, chlorinated ethenes and chlorinated ethanes. All of the listed compound classes were found along the entire length of the eastern off-site area of the landfill where sampling was performed.

9.0 CDA AND DOWNGRADIENT GROUND WATER HUMAN HEALTH RISK ASSESSMENT

The objectives of this human health risk assessment (RA) are to determine the current and future potential human health risks of residual contamination detected in: (1) the Construction Debris Area soils to the south of the landfill, and (2) ground water downgradient of the landfill. The RA was performed in accordance with USEPA's *Risk Assessment Guidance for Superfund* (RAGS) (USEPA, 1989a) and other relevant USEPA risk assessment guidance documents.

9.1 Previous Risk Evaluations

The analytical data collected during the Himco Dump Site (Donohue, 1992) and the baseline risk assessment (BRA) indicate the presence of contaminants in various media that may present a risk to human health. The BRA determined carcinogenic and noncarcinogenic risks the chemical contaminants at the site posed under current and future land use.

The following pathways were selected for detailed evaluation in the BRA under current land-use conditions:

- Inhalation of airborne particulates and VOC's released from the site [residents northeast of the site and on-site dirt-bike riders (recreational)],
- Incidental ingestion of surface soil by recreation visitors while dirt-bike riding,
- Ingestion of surface water and sediment while wading or fishing,
- Dermal contact with surface water while wading or fishing.

The following pathways were selected for detailed evaluation in the BRA under future land-use conditions and included residential, commercial, agricultural, and recreational scenarios. Future residents and workers were evaluated both on the landfill property and south of the landfill. Agricultural workers were evaluated on the landfill property only. The pathways were:

- Inhalation of particulates or VOC's released from the site,
- Incidental ingestion of surface soil,
- Ingestion of ground water,
- Inhalation of volatiles released during indoor uses of ground water,
- Dermal exposures to ground water.

The results of the BRA indicated the potential excess lifetime cancer risk for the Himco Dump Site is primarily from the use of contaminated ground water under the future use scenarios. Risks from ingestion, dermal contact and inhalation of volatiles from ground water present carcinogenic risks in the range of 4E-04 to 1E-01.

South of the landfill, downgradient, the estimated excess cancer risk to a future adult resident is 5E-03. As described in the RI report (Donohue, 1992), the method for calculating risks included the assumptions that 1) chemicals detected in soil (to represent leaching to ground water), but not detected in any ground water sample, and 2) chemicals detected in at least one ground water sample (including leachate samples), but not in wells selected to represent a given exposure point (wells located south of the landfill), were evaluated at one-half the detection limit. Therefore, approximately 80% of the estimated risk downgradient of the landfill is attributable to "not detected" chemicals in ground water. The risk is primarily due to the presence of arsenic and beryllium in ground water and polynuclear aromatic hydrocarbons (PAH's) in soil (representing leaching to ground water). For future use of the ground water under the landfill, the HI values are approximately 500 to 1,000. Antimony is the primary contributor to this risk. Other chemicals include arsenic, beryllium, cadmium, chromium, vanadium, alpha-chlordane and nitrate/nitrite.

In addition to ground water, there is an estimated excess cancer risk of 4 to 6E-04 to a future resident living south of the landfill where PAH's were detected in the soil.

An ecological risk assessment was conducted to characterize the biological resources at the site and adjacent habitats, and identify current and future potential impacts to these resources associated with releases of chemical contaminants from the site. Contaminants present in the soil where the prairie communities are located are unlikely to pose adverse impacts to resident species of plants and animals. The greatest hazard to resident organisms (small mammals) occurs in the south/southeast area of the site where contamination levels are increased and more varied. This area is highly disturbed and unlikely to support ecologically significant populations. Other areas of the site were determined to be unlikely to pose a significant threat of adverse effects to exposed organisms.

9.2 Purpose and Scope of this Risk Assessment

The purpose of this RA is to conduct human health risk evaluations for specific Himco Dump Site off-site areas that were not addressed in the Donohue baseline risk assessment (i.e., the CDA) and to evaluate ground water downgradient of the landfill using the data set included by Donohue in the BRA [1990/1991 data set (Donohue, 1992)] and the following supplemental investigations: the 1995 Pre-Design sampling event conducted by USACE [as documented in the *Final Pre-Design Technical Memorandum, Himco Dump Site, Elkhart, Indiana* (USACE, 1996)], the 1996 USEPA Supplemental Site Investigation analytical data involving ground water downgradient of the landfill, the 1998 Supplemental Site Investigation analytical data involving CDA soils and ground water downgradient of the landfill, and the 2000 Supplemental Site Investigation analytical data (April/May and November 2000) involving ground water downgradient of the landfill.

The RA CDA will evaluate multimedia risks to receptors for the Himco CDA. Initially, during Data Evaluation/Chemicals of Potential Concern Selection (COPC), the Himco CDA will be evaluated as a single exposure unit for ground water and soil. After the COPC's are selected, the CDA will be divided into exposure areas described in Section 9.5.1.2.

The investigative data and risk evaluation will provide USEPA Region 5 with additional information for determining whether further remedial elements are necessary and warranted in the Himco CDA, and for area ground water downgradient of the landfill.

9.3 Conceptual Site Model

Principle elements of the CSM for the Himco CDA and downgradient ground water are reviewed in Chapter 8.

9.3.1 Sources, Release Mechanisms, and Affected Media

The sources, release mechanisms, and affected media are described in Section 8.1.

9.3.2 Current and Future Land Use Scenarios

For purposes of the CDA human health risk assessment (RA CDA), receptors are defined as residents to the south, where the CDA extends onto the residential properties, and construction workers to the south conducting work on the residential properties.

9.3.3 Characterization of Exposure Pathways

For a site contaminant to pose a potential risk to receptors, there must be a completed exposure pathway from the affected media to the receptor. Receptor exposure pathways potentially associated with affected media are described here. Potentially completed exposure pathways for receptors are summarized below.

9.3.3.1 Soil Exposure Pathways

Soil represents a transport medium for and a secondary source of site-related contaminants at the subject sites. Potential release mechanisms for contaminants in soil include tracking, excavation, fugitive dust, and volatilization. Many factors affect release and bioaccessibility, of soil contaminants. Soil geochemistry, including temperature, pH, organic content, particle size, and moisture content, and contaminant characteristics such as vapor pressure, solubility, and adsorption/desorption rates, are examples of such factors. Uptake of soil contaminants also is affected by the biology of the receptor, including variables such as age, size, sex, lipid content, and metabolic and excretion rates.

Three soil exposure intervals were developed to maximize use of the available CDA soil data and to better quantitatively assess the types of exposures for different receptors: surface soils (0 to 0.5 feet bgs), and mixed soils (0 to 2 feet bgs and 0 to 6 feet bgs). Potential receptors could be exposed to contaminants in soil via ingestion and dermal contact with soil and soil-derived dust, as well as via inhalation of contaminants in fugitive dust and/or contaminants volatilizing from the soil into the surrounding air.

9.3.3.2 Ground Water Exposure Pathways

The release mechanisms for ground water include direct releases at or below the water table and leaching of contaminants from soil in infiltrating precipitation. Completed exposure pathways from ground water were assumed to be possible for receptors (e.g. future residents) that use extracted ground water for household use and during showering or bathing (currently residents are on a municipal water supply; although, private wells are still in place and could be used as a drinking water source). The probability of contact by intrusive workers with the ground water during construction was considered to be low. [Based on the most recent round of ground water sampling in March, 2000, the depth to the upper aquifer is approximately 6 to 15 feet bgs. According to the USGS (USGS, 1991), ground water levels fluctuate seasonally and generally are highest in April and May. For 1980 - 1989, the average seasonal fluctuation was 4.8 feet]. In addition, it was assumed that if any ground water in a construction area was encountered, it would be pumped out of the excavation, thereby reducing receptor contact to insignificant levels.

9.3.3.3 Air Exposure Pathways

Air represents a potential medium for contaminant transport from soils and ground water at the Himco CDA. Release mechanisms could include fugitive dust generation by wind or surface disturbances, and emission of VOC's into the atmosphere. Emissions of VOC's from soil vapors may be triggered or enhanced by ground surface disturbing activities, which serve to loosen near-surface soils. Volatilization of contaminants located in subsurface soils or in ground water, and the subsequent mass transport of these vapors into indoor air spaces also constitutes a potential inhalation exposure pathway.

Receptors evaluated at the subject site could be exposed (via the inhalation route) to contaminants in fugitive dust and VOC's volatilizing from soils or ground water that could migrate through the soil medium and discharge into ambient air and indoor spaces. When considering fugitive dust in particular, two phenomena give rise to dust in air to which a receptor might be exposed:

- Activity on the site; and
- Action of the wind.

Airborne (fugitive) dust to which a construction worker would be exposed is more likely to be raised by the nature of the activities on the site (excavating soil) rather than the action of the wind. Residential receptors in contrast, are more likely to be exposed to fugitive dust via wind erosion. However, because most resident yards typically have ground cover/vegetation, for this investigation it was assumed that levels of airborne dust to which a resident is exposed is insignificant when compared to other routes of exposure.

The discharge of volatiles from soil vapor into ambient air or indoor air was not assessed in this RA. Although soil gas data were collected in this investigation (and discussed in Chapter 5), the objectives were to determine if soil gas was indeed migrating from the landfill boundary, and to aid in evaluating remedies proposed for the site. These data are not suitable for modeling volatile gas concentrations in ambient air and homes and therefore not quantified; however, Figures 5-1 through 5-4 present the contoured concentration data for the compound classes BTEX, chlorinated ethenes, chlorinated ethanes and vinyl chloride. All of the listed compound classess were found along the entire length of the southern perimeter of the landfill where sampling was performed.

All detected compounds appear to be distributed similarly, with higher concentrations measured just off the south boundary of the landfill, and a trend of decreasing concentrations moving away from the landfill perimeter; with the highest detected concentrations found in the southeast corner of the site just northwest of the intersection of County Road 10 and John Weaver Parkway.

9.4 Evaluation of the Site Characterization Data for the CDA

9.4.1 Data Evaluation

This section briefly reviews the decisions made regarding the use of the data for risk assessment purposes. Previous analytical data included in the data sets are described in Section 9.2. The data collected for ground water from the described events was evaluated with respect to the criteria presented in Chapter 4. The analytical data deemed acceptable for use in this RA CDA is presented in Table 2-1. The RA CDA data sets were developed for downgradient ground water for wells WT116A and 119A and entire CDA soils encompassing 0 to 6 feet bgs. Monitoring well WT116A was chosen as this well is located within the CDA, and monitoring well WT119A was chosen as this well is located immediately downgradient of both the CDA and WT116A. These monitoring wells were also chosen because they represent the most contaminated area of the ground water plume emanating from the landfill and CDA both horizontally and vertically, and have the most potential to affect the receptors of concern. Monitoring wells WT111A, WT116B, and WT118B are located either within or downgradient of the landfill/CDA; however, contaminant levels detected in ground water samples from these wells are significantly less than those found in monitoring wells WT116A and WT119A. Monitoring wells not immediately downgradient of the CDA were not considered for use in this risk assessment.

The data sets were developed using the following additional criteria:

- Rejected ("R"-qualified) data were excluded from the RA CDA data sets.
- Chemicals which were analyzed for but not detected, were reported with a "U". These sample results, including those qualified with a "UJ", were used in the risk assessment as non-detects where applicable (background ground water).
- Any detected value for an analyte, which was also detected in an associated blank, is qualified with a "B" unless the amount present is less than ten times the blank concentration for the common laboratory contaminants or five times the amount present in the blank for all other analytes. Data that is qualified "B" are used in the same way as positive data that do not have this qualifier. Any detected value for an analyte that is less than ten times the amount measured in an associated blank for the common laboratory contaminants or five times the amount measured for all other analytes is qualified "UB". Analytes qualified "UB" were not used in the risk assessment.
- If a single, unqualified analyte value was provided for a given sample/location/date, this value was included in the RA CDA data sets.
- Values reported as estimated ("J" qualified) were included in the data sets, as if they were unqualified.
- If a chemical was detected at least once in ground water, surrogate values for any non-detects for that analyte in the matrix were included in the risk data sets at one-half the contract-required quantitation limit (CRQL) or the sample quantitation limit (SQL), where applicable (background ground water).
- For duplicate soil and ground water sample pairs, the most conservative (i.e., greater) value was used. If both values were non-detects, the value representing the highest CRQL or SQL was used, following the SQL surrogate method described above, as applicable (background ground water).

9.4.2 Methodology for Selection of Chemicals of Potential Concern

All chemicals detected in sampled media in the Himco CDA (to include downgradient ground water) were determined acceptable for use, except as noted in Chapter 4 and on Table 2-1, and evaluated to identify preliminary chemicals of potential concern (COPC's) for the identified receptors. Several screening steps were performed to focus the RA CDA on chemicals with a potential to pose a risk to human health. The screening steps included:

- Elimination of essential nutrients;
- Comparison of site concentrations to upgradient concentrations for metals (i.e. site-attribution analysis). This was performed with ground water only; and
- Toxicity screening.

9.4.2.1 Essential Nutrient Screening

A chemical may be excluded as a COPC if it is an essential trace element or dietary requirement, and conservative exposure to the element in site media would result in intakes at or less than health-protective levels. If essential nutrients were present in soil or ground water, screening was performed by comparing maximum detected concentrations of these analytes to the screening level derived using recommended daily allowances (RDA's) or adequate daily dietary intake levels established for mineral and trace nutrients for children ages 1-10 (if available) and adults (NRC, 1989). To make this comparison, the RDA was first converted to a soil concentration by dividing by the daily intake rate of 0.0002 kg soil/day (the USEPA default residential soil ingestion rate for children). For nutrients in ground water, the screening level was derived by dividing the RDA by 2 L water/day (the USEPA default residential drinking water ingestion rate for adults). If the maximum detected concentration was $\geq$ to the RDA-based screening level, the nutrient was listed as a COPC or analyzed further by other screening criteria in the RA CDA. If the maximum detected concentration was < the RDA, no further analysis was required.

No essential nutrients were retained as site-related COPC's in soil. Calcium and iron were the only two essential nutrients retained as site-related COPC's in ground water. Both calcium and iron were present in ground water at the Himco Dump Site at concentrations greater than their respective intakes at health-protective levels. The calcium and iron screening exceedence occurred in 1995 and April/November 2000 in WT116A. Although no adverse effects have been observed in many healthy adults consuming up to 2,500 mg of calcium per day, high intakes may induce constipation and place up to half of otherwise healthy hypercalciuric males at increased risk of urinary stone formation. A high calcium intake may inhibit the intestinal absorption of iron, zinc, and other essential nutrients (NRC, 1989). With excess dietary intake, iron overload may include disturbances of liver function, diabetes mellitus, endocrine disturbances, and cardiovascular effects (NRC, 1989).

Although sodium was not retained as a site-related COPC in ground water, it should be noted that the USEPA Office of Water has issued a Drinking Water Advisory to provide guidance to communities that may be exposed to drinking water containing sodium chloride or other sodium salts. This advisory recommends reducing sodium concentrations in drinking water to between 30 and 60 mg/L. This range is based on esthetic effects (i.e., taste), and would only contribute 2.5 - 5 percent of the daily dietary goal of 2,400 mg/day, if tap water consumption is 2 liters/day (USEPA, 2002a). At present time, the USEPA guidance level for sodium in drinking water is 20 mg/L; developed for those individuals restricted to a total sodium diet of 500 mg/day (USEPA, 2002a).

The maximum detected sodium concentration found in residential wells to the south is 214 mg/L, which is above the advisory level, but below the daily dietary level of 250 mg/L. However, the daily contribution of sodium in the diet through drinking site ground water would be almost 100 percent, even for an un-restricted diet.

9.4.2.2 Comparison with Background/Site-Attribution

Validated analytical results for non-nutritive metals detected in upgradient and downgradient ground water were compared to identify constituents present at concentrations greater than upgradient levels (i.e. site-related). All organic chemicals detected were considered to be site-related, and were not subject to site-attribution analysis.

A site-attribution evaluation was not performed for the soil medium. It has not been identified whether the site-specific background soils data presented in the RI/FS (Donohue, 1992) are representative of naturally occurring or anthropogenic levels. In addition, the sample depths for the background soils data set are not consistent with the sample depths for the current investigation; making it difficult to evaluate the two data sets. The background soils data may also not be a good indicator of health levels. Background arsenic of 1.5 mg/kg is greater than the residential risk-based screening value of 0.39 mg/kg (USEPA, 2000a); the value of 0.39 mg/kg is representative of an excess cancer risk of 1E-06. Background arsenic was calculated by averaging the arsenic results from locations GT2A (B02), GT4A (B04), and GT6A (B06) at 0-2 feet (Donohue, 1992)

Upgradient ground water data were collected from the 1995, 1998, and April/May 2000 ground water sampling events. Data from the events for upgradient wells WT102A and WT112A were combined and averaged (arithmetic mean) to determine upgradient ground water quality. The maximum detected concentration of a chemical constituent from the ground water data set from the Himco Dump Site was then compared to the average upgradient ground water concentration as part of the COPC selection process. If the maximum detected concentration was greater than the average upgradient concentration for an analyte, then the analyte was retained as a COPC.

A summary of site-related non-nutritive metals in downgradient ground water is as follows:

-Aluminum
-Antimony
-Arsenic
-Copper
-Barium
-Cobalt
-Lead
-Manganese
-Selenium
-Thallium
-Mercury
-Vanadium
-Zinc
-Cyanide

9.4.2.3 Toxicity Screening/Risk-Based Screening Comparisons

Maximum detected concentrations and risk-based screening values for preliminary COPC's in each medium for CDA soils and downgradient ground water at the site were compared to focus the RA CDA on those chemicals with a potential to pose an unacceptable risk to the receptors evaluated. Chemicals that exceeded their respective risk-based screening values were retained for further analysis. The risk-based screening values were based on chronic receptor-specific exposures.

The analytical data were compared to Preliminary Remediation Goals (PRG's) developed by USEPA Region 9 (USEPA, 2000a) for residential exposure to soil (via ingestion, inhalation, and dermal absorption) and ground water (via ingestion and inhalation). The screening process is based upon a PRG excess cancer risk level of 10^{-6} and an adjusted hazard quotient (HQ) of 0.1 for noncarcinogens. These adjustments are made to provide additional protection for simultaneous exposure to multiple chemicals. For carcinogens, the method for calculating PRG's uses an integrated 30-year adult exposure that takes into account the difference in daily soil ingestion rates, body weights, and exposure duration for 6 years as a child and 24 years as an adult. This health-protective approach is chosen to take into account the higher daily rates of soil ingestion in children as well the longer duration of exposure that is anticipated for a long-term resident. For noncarcinogenic concerns, the more protective method of calculating a soil PRG is to evaluate childhood exposures separately from adult exposures (i.e., an age-adjustment factor is not applied as was done for carcinogens). This approach is considered conservative because it combines the higher 6-year exposure for children with chronic toxicity criteria.

Soil screening levels for the protection of ground water were not included in the screening process because ground water was directly sampled and analyzed in past and present USACE Himco Dump Site investigations.

9.4.2.4 Chemical-Specific Screening Considerations for Lead

For surface and near surface soils, the USEPA Office of Solid Waste and Emergency Response (OSWER) 400 mg/kg lead screening level for residential soil was used as the screening level for inorganic lead (USEPA, 1998, 1994c). The 15 µg/L action level for lead in drinking water was used to screen inorganic lead and was exceeded in ground water.

For soils, lead was detected above the residential screening level in Land Parcel F in one surface soil sample at an estimated concentration of 695 mg/kg. This concentration, being over the 400 mg/kg screening level would warrant additional investigation. Lead was also detected in other surface, near surface and subsurface samples at Land Parcels F, D, S and O. Although the concentrations detected were below the screening level of 400 mg/kg, the concentrations represent lead concentrations in the total soil sample (unsieved). USEPA lead models consider the fine particle fraction from sieved soil samples (the fraction that sticks to hands and most likely to accumulate in the indoor environment) as the primary source of the ingested soil and dust (USEPA, 2000b). Therefore,

comparison of the total soil concentration to the modeled screening value of 400 mg/kg may be an underestimate of the overall risk to lead. Although lead toxicity has been well-studied, toxic effects from chronic low-level exposure are subtle and normally cannot be detected in children and adults. Hence, establishing a clear toxicity threshold has proven difficult. The adverse effects of lead on the central nervous system and intellectual potential in young children are long-lasting and may be permanent. For investigating childhood lead exposure, the Integrated Exposure Uptake Biokinetic (IEUBK) model would be used to predict blood levels associated with site-related data (USEPA, 1994d). For investigating adult lead exposure (non-residential), screening levels generated using the Adult Lead Methodology (USEPA, 1996a) and blood lead data on U.S. adult females from the combined phases of the Third National Health and Nutrition Evaluation Survey (USEPA, 2002b) range from 800 (for protection of the most sensitive racial/ethnic group) to 1100 mg/kg (for consideration of all groups) for the Midwest Census Region. The blood lead levels are used as an indicator of risk, where risk is defined as the percent probability of exceeding the blood level of concern (i.e., 10 µg/dL). In general, although lead was detected in only one surface soil sample above the lead screening level of 400 mg/kg, lead was detected in other total soil samples; not the fine fraction where lead concentrations may be enriched and exceed the modeled screening value.

9.4.2.5 Treatment of Non-Detects

In some cases, the SQL or CRQL's for certain analytes were equal to, or greater than (approximately 2 - 1,000 times), the risk-based screening levels (RBSL's) of the corresponding analytes (Table 9-1). In such cases where the quantitation limit was $\geq$ to the RBSL, and all analytical results for a particular contaminant and medium for the entire Himco CDA were reported as "non-detects", it was not appropriate to remove these analytes from the risk assessment process.

The compounds not detected in the CDA soils and area ground water that have detection limits greater than RBSL's (analyzed at a dilution factor of one), are listed in Table 9-1. These chemicals are noted as being COPC's, but were eliminated from the quantitative risk assessment. If the chemical was able to be detected at a lower quantitation limit, then its presence and concentration could in fact be toxic and contribute significantly to the reported estimated risks.

9.4.3 Selection of Chemicals of Potential Concern for the CDA

All chemicals detected in soil and ground water in wells WT116A and WT119A in the entire CDA were evaluated to identify COPC's. The chemicals remaining upon completion of the data evaluation steps (Section 9.4.1) and essential-nutrient and site-attribution analysis steps (Section 9.4.2) were retained for further evaluation for the site-specific human health RA CDA. A comparison was made between the maximum detected concentrations and PRG's for each media. Chemicals that exceeded their respective PRG's were retained as COPC's. The following subsections summarize the human health chronic toxicity screens used to determine COPC's for soil and ground water at the Himco CDA.

9.4.3.1 Soil

A soil chronic toxicity screen was conducted for the entire CDA mixed (0 to 6 foot bgs) soil interval. Maximum detected preliminary COPC concentrations were compared to USEPA Region 9 (USEPA, 2000a) residential PRG's, as described in Section 9.4.2.3. Chemicals with soil concentrations less than the applicable PRG's were eliminated from further risk analysis.

The comparison of maximum detected mixed soil chemical concentrations to the PRG screening criteria for the Himco CDA soils is presented in Table 9-2. The chemicals that exceeded their respective screening criteria and are retained as COPC's for the quantitative risk evaluation are the following:

-Aluminum
-Antimony
-Arsenic
-Copper
-Manganese
-Mercury
-Nickel
-Benzo(a)anthracene
-Benzo(b)fluoranthene
-Benzo(k)fluoranthene
-Benzo(a)pyrene
-Indeno(1,2,3-cd)pyrene
-Dibenz(a,h)anthracene

9.4.3.2 Ground Water

Downgradient ground water data were evaluated for the Himco Dump Site. Toxicity screening, based upon potential ingestion of ground water, was performed by comparing the maximum detected chemical concentration in ground water to USEPA Region 9 (USEPA, 2000a) residential tap water PRG's, as described in Section 9.4.2.3. Those chemicals with maximum concentrations in ground water less than the applicable tap water PRG's were eliminated from further risk analysis.

The comparison of maximum detected chemical concentrations in ground water to the PRG screening criteria for the Himco Dump Site is presented in Table 9-3. The chemicals that exceeded their respective screening criteria and are retained as COPC's for the quantitative risk evaluation are the following:

-Antimony
-Arsenic
-Iron
-Manganese
-Thallium
-1,2-Dichloropropane
-Benzene
-Carbazole
-Bis(2-ethylhexyl)phthalate
-Vinyl chloride

9.5 Exposure Assessment

9.5.1 Characterization of the Exposure Setting

The exposure assessment consists of three main steps:

- Evaluation of exposure pathways and identification of receptors;
- Estimation of exposure-point concentrations; and
- Estimation of intake.

Each of these steps is described in detail in the following subsections.

9.5.1.1 Land-Use Considerations

For purposes of this RA, both the current and expected future land uses for the area to the south, where the CDA extends onto the residential properties, are expected to remain residential.

9.5.1.2 Exposure Areas

The RA CDA evaluates multimedia risks to receptors for the Himco CDA. Initially during Data Evaluation/Chemicals of Potential Concern Selection, the Himco CDA was evaluated as a single operable unit for ground water and soil. After the COPC's had been selected, the CDA was then divided into exposure areas or sub-sites. The exposure areas evaluated in the RA CDA are associated with the following sources of soil and ground water contamination at the Himco CDA:

- **Individual residences/land parcel soils off-site in the Himco CDA.** Land parcel soils M, O, P, S, F, and D (Figure 2-1) were individually (quantitatively) assessed using samples from Soil Borings SB03; SB04, 05, and 06; SB08 and SB10; SB07, SB09, SB11, SB13, SB14, and SB12; SB15, SB16, SB17, SB18, and SB20; and SB19, respectively. For Land Parcels N, T, R and Q, soil samples were taken at nearby locations; therefore, USACE Omaha District and the USACE Hazardous Toxic and Radioactive Waste Center of Expertise conducted a geostatistical analysis (on arsenic and benzo(a)pyrene only, because the estimated soil risks for the resident in Land Parcels M, O, P, S, F, and D appeared to be driven by arsenic and benzo(a)pyrene) in order to estimate soil concentrations to be used in the risk assessment. The results of the geostatistical analysis are presented in Appendix L.
- **Ground water well or well-pair locations.** Monitoring wells WT116A and WT119A were chosen as described in Section 9.4.1.

9.5.1.3 Exposure Population/Receptor Identification

A site-specific conceptual site model (CSM) (Figure 8-1) was used to qualitatively define the type of potential exposures to contaminants at or migrating from a site (i.e., to systematically evaluate the impact of chemicals in relevant media to potential receptors). Such models are mechanisms for identifying potentially completed exposure pathways between physical media affected by site-related contamination and potential receptors. A general description of CSM's is provided in Section 9.3, and the potentially complete exposure pathways and receptors at the Himco CDA are identified in this section.

Consistent with RAGS (USEPA, 1989a), current and future land-use scenarios were considered for each sub-site. Potential receptors at the Himco CDA include current and future off-site residents (adult and child) and current and future off-site construction workers involved in resident home improvement projects.

9.5.2 Evaluation of Exposure Routes and Pathways

9.5.2.1 Current and Future Off-Site Residents

Current and future off-site residents are defined as individuals that reside near the Himco CDA. The CDA extends south from the landfill boundary and onto property (off-site) owned by adjacent landowners. Current and future off-site residents were assumed to be exposed to surface soils, and mixed soils (gardening) in the land parcel areas (Figure 2-1), and exposed to ground water at well locations WT116A and WT119A, previously discussed in Section 9.4.1 and illustrated in Figure 2-2. Current and future off-site residents were assumed to be exposed to surface soils, and mixed soils (down to 2 feet bgs) via ingestion, and dermal contact.

Inhalation of particulate matter and volatiles from soil were not quantified because: 1) currently, the residential parcels have vegetative cover, such as grass and wooded area, and it is reasonable to assume continued maintenance of this vegetative cover. It is also assumed that the levels of airborne dust are less significant compared to other routes of exposure, and 2) soil COPC's identified in the CDA were not volatile [defined as having a Henry's Law constant greater than 10^{-5} atm-m^3/mol and a molecular weight less than 200 g/mol (USEPA, 1989a)].

In addition, residents were assumed to be exposed to ground water via ingestion (drinking water), dermal contact, and inhalation of volatiles while performing household activities, and showering or bathing.

9.5.2.2 Current and Future Off-Site Construction Worker

A current and future off-site worker is defined as an individual who works in the CDA near the Himco Dump Site, and is involved in resident home improvement construction projects. Intrusive

workers (i.e., construction workers) were assumed to be exposed to mixed soils (0 to 6 feet bgs) via ingestion of soil, dermal contact with soil, and inhalation of VOC's and particulates. Inhalation of VOC's was not quantified because the soil COPC's were non-volatile. It was assumed (based on professional judgement) that any construction activities involving mixed soil disturbances would encompass 180 days over a 9 month time-frame [represents a 5 day work week for 38 weeks; with 10 days of inclement weather (a resident home improvement project)].

Because the depth to the upper aquifer averages approximately 10 feet bgs, there is a low probability of contact by a construction worker during excavation activities. Given modern construction techniques, the use of dewatering pumps, and Occupational Safety and Health Administration (OSHA) prohibitions against working in excavations with free standing water; exposure to ground water was assumed to be an incomplete pathway for the construction worker.

9.5.3 Estimation of Exposure-Point Concentrations for the CDA

Exposure-point concentrations (EPC's) are intended to be representative of the concentrations of chemicals in a given medium to which a receptor may be exposed (i.e., the exposure point). For the RA CDA, EPC's were estimated using analytical data obtained from site sampling or using modeling (e.g., indoor air concentrations derived from chemical concentrations in ground water). Exposure point concentrations for exposures to particulates and VOC's in air were estimated as described in *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) and the Andelman model (Andelman, 1990). Current concentrations in soil and ground water were assumed to be representative of future concentrations. Table 9-4 summarizes the potentially exposed receptors, and how the EPC's were developed for this RA CDA.

9.5.3.1 Exposure-Point Concentrations for Direct Soil Contact

Once COPC's were selected, the maximum chemical concentration in each exposure/sampling interval from each individual parcel of land was used as the EPC in site soils (Table 9-5). The maximum chemical value was chosen because the individual parcel data sets had fewer than 10 samples, and thus provide poor estimates of the upper-confidence-limit of the arithmetic mean concentrations. Table 9-4 summarizes the pathways considered for each receptor population and the manner in which the exposure point concentrations were developed.

9.5.3.2 Exposure-Point Concentrations for Contaminants in Fugitive Dust

Exposure point concentrations for fugitive dust inhalation (for the construction worker) were calculated using the following equation (USEPA, 1996b).

$$C_a = \frac{C_s}{PEF}$$

where:

C_a = contaminant concentration in outdoor air at the exposure point (mg/m^3);
C_s = contaminant concentration in soil (mg/kg); and
PEF = activity-specific soil-to-air particulate emission factor (m^3/kg) (1.42E+09 m^3/kg).

The particulate emission factor (PEF) relates the concentration of the soil COPC with the concentration of dust particles in the air. This calculation addresses dust generated from open sources, which is termed "fugitive" because it is not discharged into the atmosphere in a confined flow. Particulate emission factor calculations included standard default values and the Q/C term specific to the site's sizes and meteorological conditions (specifically, the Q/C term for Chicago, IL, and a 0.5 acre contaminated area). As such, particulate concentrations in air were calculated by dividing the mixed soil concentrations for each COPC in each land parcel by the default PEF of 1.42E+09. The numerical values for the equation variables for the soil media are presented in Table 9-7.

9.5.3.3 Contaminants Volatilized from Soil

Since there were no volatiles identified as COPC's in surface or subsurface soil, inhalation of vapors from the soil is considered incomplete and was not evaluated further in this RA CDA.

9.5.3.4 Exposure-Point Concentrations for Ground Water

The results from monitoring wells WT116A and WT119A from the investigations described in Section 9.2 for the ground water from these monitoring wells were utilized in the risk assessment to determine risk via ground water. In addition, the analytical data were reviewed with respect to the criteria in Chapter 4. Table 2-1 describes the analytical data deemed acceptable for use in the risk assessment based on the criteria in Chapter 4.

Because multiple sampling results were available for the individual wells, the maximum concentration was used to obtain the best approximation of the EPC for chemicals in ground water (Table 9-6).

9.5.3.5 Exposure-Point Concentrations for Air Volatiles from Ground Water

Exposure-point concentrations of VOC's in air due to volatilization from ground water were estimated for showering and household use exposures, (applicable to the residential receptor), using the Andelman models (Andelman, 1990). Although a child residential receptor may typically take baths rather than shower, the shower model (using a bath duration time) was still assumed to be an adequate and conservative estimate for deriving EPC's in air from ground water for a child resident bathing in an enclosed space. This assumption is based on the following: 1) water volumes from a shower versus a bath are comparable (150 L); as well as 2) comparable water use transfer

efficiencies (percent volatilization) as determined for radon by Richard and Gazelle (1981) as referenced by Andelman (Andelman, 1990) (shower - 63% vs. bath - 47%).

The Andelman models for a shower and whole-house exposures are simple models. It employs the use of a one-compartment area and assumes the rate of volatilization is constant. It further assumes that all volatile constituents (i.e., constituents with a Henry's law constant of E-06 atm-m^3/mol or greater) are equally volatilized and that below a threshold Henry's law constant of E-06 atm-m^3/mol no volatilization occurs. In the case of very volatile compounds, this approach may be adequate, but it will tend to overestimate exposure if semivolatile constituents are included in risk assessment.

Exposure point concentrations of VOC's in air due to volatilization from ground water during showering were calculated with the following equation (numerical values for equation variables are presented in Table 9-8):

$$C_a = \frac{C_w \times f_s \times F_{w-s} \times t}{2V}$$

where:

C_a	=	air concentration in shower ($\mu g/m^3$);
C_w	=	concentration of chemicals in the ground water ($\mu g/L$);
f_s	=	fraction volatilized in the shower (unitless);
F_{w-s}	=	flow rate of the shower water (L/hr);
t	=	time in the shower (hr); and
V	=	volume of the shower chamber (m^3).

Exposure-point concentrations of VOC's in air due to volatilization from ground water during household use activities, applicable to the resident, were estimated with the following equation (numerical values for equation variables are presented in Table 9-8):

$$C_{a-h} = \frac{C_w \times F_{w-h} \times f_h}{HV \times k \times ER}$$

where:

C_{a-h}	=	air concentration in the house (mg/m^3);
C_w	=	concentration of COPC in the ground water (mg/L);
F_{w-h}	=	water use rate in the house (L/day);

f_h = fraction volatilized in the house (unitless);
HV = volume of the house (m^3);
k = mixing coefficient (unitless); and
ER = air exchange rate (exchanges/day).

9.6 Estimation of Media Intakes

Intake, expressed as milligrams of chemical per kilogram of body weight per day (mg/kg-day), is obtained by multiplying the EPC by several exposure factors which are specific to an exposure scenario.

USEPA (USEPA, 1992) defines two types of exposure estimates currently used for Superfund risk assessments: a reasonable maximum exposure (RME) and a central tendency (CT) exposure. The RME is defined as the highest exposure that reasonably could be expected to occur for a given exposure pathway at a site, and is intended to account for both uncertainty in the contaminant concentration and variability in the exposure parameters. Because this is a supplemental risk evaluation rather than a baseline risk assessment, only the RME scenario was estimated. This approach is conservative because the RME is based on the upper bound estimates of the input parameters.

In accordance with USEPA guidance (USEPA, 1989a), intakes for carcinogens were calculated differently from those for noncarcinogens. For carcinogens, intake was averaged over an assumed lifetime of 70 years. This is appropriate because cancer is considered to be a non-threshold phenomenon and because multiple individual chemical exposures which could result in the development of cancer are accrued over a lifetime. The probability of developing cancer is believed to be proportional to the duration and intensity of exposure. That is to say, the probability of developing cancer is proportional to the dose of chemical absorbed into the body, the frequency of exposure, and the length of exposure.

Because contact rates, body weights, exposure durations, and in some instances, exposure times are different for children and adults, carcinogenic risks for residential receptors during the first 30 years of life were calculated by age adjusting for each exposure route. The age adjustment estimates the total exposure to an individual by combining contact rates, body weights, and exposure durations for children 1 to 6 years old and others from 7 to 31 years old. The equations used for age adjusting for the ingestion, dermal contact, and inhalation pathways are discussed in further detail later in this section.

For noncarcinogens, the intake was averaged over the duration of exposure. This reflects the assumption that noncarcinogenic effects have a toxicity threshold. Adverse health effects would result if the toxicity threshold were exceeded for a period of time during an average lifetime. That is, lifetime exposure of a receptor to a chemical at a concentration below the threshold is not expected to result in adverse effects.

In this RA CDA, a childhood-only exposure scenario was used to evaluate off-site residential noncancer hazards. This approach is considered conservative because it combines the higher 6-year exposure (and hence higher intake) for children with chronic toxicity criteria. The issue of using a chronic reference dose (RfD) to evaluate childhood exposures was explored by USEPA (USEPA, 1996b) for developing Soil Screening Levels (SSL's), which does use the childhood-only approach. USEPA (USEPA, 1996b) noted that this approach was appropriate for chemicals such as nitrate/nitrite and fluoride, for which the verified chronic oral RfD's are based on empirical data from childhood exposures, and for chemicals with steep dose-response curves. For most other chemicals USEPA determined that this approach may be overly protective.

The primary exposure parameters used to estimate risk/hazard per the equations presented below, the justification for the parameter values used, and the references for the values selected are summarized in Tables 9-7 and 9-8.

9.6.1 Equations for Estimating Intake

9.6.1.1 Incidental Ingestion of Soil

Incidental soil ingestion is a plausible exposure pathway for the off-site construction worker and the adult and child resident. The ingestion intake of COPC in soil for the construction worker (cancer and noncancer evaluation) and child resident (noncarcinogenic) was estimated from the equation:

$$I_s = \frac{C_s \times IR \times FI_s \times EF \times ED \times CF}{BW \times AT}$$

where:

I_s	=	intake, the amount of COPC in soil (mg/kg-day);
C_s	=	concentration of COPC in soil (mg/kg);
IR	=	ingested rate of soil (mg/day);
FI_s	=	fraction of exposure attributed to site soil (unitless);
EF	=	exposure frequency (days/year);
ED	=	exposure duration (years);
CF	=	conversion factor (1E-06 kg/mg);
BW	=	body weight (kg); and
AT	=	averaging time (days).

The FI from the source medium is defined as the fraction of soil contacted that is presumed to be contaminated (USEPA, 1989a). If site-specific considerations should indicate that exposure exists for two or more media, then the value of FI would be less than one for each source media. The

fraction of exposure attributed to soil was assumed to be 1.

Because daily soil ingestion rates are different for children and adults, carcinogenic risks during the first 30 years of life were calculated using age-adjusted factors. These factors approximate the integrated exposure from birth until age 30 by combining contact rates, body weights, and exposure durations for two age groups, small children and adults. The equation used to calculate the age-adjusted factor for the ingestion pathway for the off-site resident is shown below:

$$IFS_{adj} = \frac{ED_{child} \times IR_{child}}{BW_{child}} + \frac{(ED_{tot} - ED_{child}) \times IR_{adult}}{BW_{adult}}$$

where:

IFS_{adj}	=	age adjusted ingestion rate factor for soil ingestion(mg-yr/kg-day);
ED_{child}	=	exposure duration for a child (years);
IR_{child}	=	ingestion rate of a child (mg/day);
BW_{child}	=	body weight of a child (kg);
ED_{tot}	=	exposure duration for a resident (years);
IR_{adult}	=	ingestion rate of an adult (mg/day); and
BW_{adult}	=	body weight of an adult (kg).

The equation used for estimating the intake for carcinogenic constituents via ingestion of soil for the age-adjusted resident is:

$$I_s = \frac{C_s \times IFS_{adj} \times EF \times CF \times FI_s}{AT}$$

where:

I_s	=	intake of COPC in soil (mg/kg-day);
C_s	=	concentration of COPC in soil (mg/kg);
IFS_{adj}	=	age-adjusted ingestion rate factor for soils (mg-yr/kg-day);
EF	=	exposure frequency (days/year);
CF	=	conversion factor (1E-06 kg/mg);
FI_s	=	fraction of exposure attributed to site soil (unitless); and
AT	=	carcinogenic averaging time (days).

9.6.1.2 Dermal Contact with Soil

Dermal exposure to COPC's from soil is a potential exposure pathway for the off-site construction worker and for the adult and child resident. Dermal exposure to contaminants in soil was estimated using the methodology and algorithms described in *Dermal Exposure Assessment: Principles and Applications* (USEPA, 1992).

The dermally absorbed dose of a soil COPC for the construction worker (cancer and noncancer evaluations) and for the resident (noncancer evaluation) was estimated from the equation (USEPA, 1992):

$$DAD = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT}$$

where:

DAD	=	dermally absorbed dose of COPC (mg/kg-day);
DA_{event}	=	dose absorbed per event (mg/cm^2-event);
SA	=	surface area of the skin available for contact with the soil (cm^2);
EF	=	exposure frequency (events/year);
ED	=	exposure duration (years);
BW	=	body weight (kg); and
AT	=	averaging time (days).

DA_{event} (mg/cm^2-event) for contaminants in soil was calculated using the following equation (USEPA, 1992):

$$DA_{event} = C_s \times CF \times AF \times ABS$$

where :

DA_{event}	=	dose absorbed per event (mg/cm^2-event);
C_s	=	concentration of COPC in soil (mg/kg);
CF	=	conversion factor (1E-06 kg/mg);
AF	=	soil-to-skin adherence factor (mg/cm^2-event); and
ABS	=	absorption fraction (unitless, chemical-specific value).

Absorption fraction (ABS) values have been empirically determined for very few chemicals. USEPA default values were used where chemical-specific data are unavailable.

The dermally absorbed dose for the age-adjusted off-site resident (cancer evaluation) was calculated by:

$$DAD = \frac{DA_{event} \times SFS_{adj} \times EF}{AT}$$

where:

DAD	=	dermally absorbed dose of COPC (mg/kg-day);
DA_{event}	=	dose absorbed per event (mg/cm^2-event);
SFS_{adj}	=	age-adjusted soil skin contact factor (cm^2-year/kg);
EF	=	exposure frequency (events/year); and
AT	=	carcinogenic averaging time (days).

The age-adjusted soil skin contact factor is as follows:

$$SFS_{adj} = \frac{ED_{child} \times SA_{child}}{BW_{child}} + \frac{(ED_{tot} - ED_{child}) \times SA_{adult}}{BW_{adult}}$$

where:

SFS_{adj}	=	age-adjusted soil skin contact factor (cm^2-year/kg);
ED_{child}	=	exposure duration, residential child (years);
SA_{child}	=	surface area of skin available for contact with soil, residential child (cm^2);
BW_{child}	=	body weight, child (kg);
ED_{tot}	=	exposure duration, resident, total (years);
SA_{adult}	=	surface area of skin available for contact with soil, residential adult (cm^2); and
BW_{adult}	=	body weight, adult (kg).

9.6.1.3 Inhalation of Particulates/Fugitive Dust

The construction worker may be exposed to airborne dust from surface and subsurface soils. The following equation was used to estimate the inhaled dose of COPC's in air:

$$I_a = \frac{C_a \times IR \times EF \times ED}{BW \times AT}$$

where:

I_a	=	inhaled dose of COPC (mg/kg-day);
C_a	=	concentration of COPC in air (mg/m^3);
IR	=	inhalation rate (m^3/day);
EF	=	exposure frequency (days/year);
ED	=	exposure duration (years);
BW	=	body weight (kg); and
AT	=	averaging time (days).

9.6.1.4 Ingestion of Ground Water

Ingestion of COPC's in drinking water is a plausible exposure pathway for the off-site adult and child resident. The intake of COPC in ground water for the child resident (noncancer) was estimated as follows:

$$I_w = \frac{C_w \times IR \times EF \times ED \times CF}{BW \times AT}$$

where:

I_w	=	intake of COPC in drinking water (mg/kg-day);
C_w	=	concentration of COPC in ground water (µg/L);
IR	=	drinking water ingestion rate (L/day);
EF	=	exposure frequency (days/year);
ED	=	exposure duration (years);
CF	=	conversion factor (1E-03 mg/µg);
BW	=	body weight (kg); and
AT	=	averaging time (days).

The ingestion intake (cancer evaluation) was calculated using an age-adjusted ingestion rate factor to reflect an average daily lifetime exposure for the resident. The age-adjusted water ingestion rate factor is as follows:

$$IFW_{adj} = \frac{ED_{child} \times IRW_{child}}{BW_{child}} + \frac{(ED_{tot} - ED_{child}) \times IRW_{adult}}{BW_{adult}}$$

where:

IFW_{adj}	=	age-adjusted ingestion rate factor for drinking water (L-yrs/kg-day);
ED_{child}	=	exposure duration for a child (years);
IRW_{child}	=	drinking water ingestion rate of a child (L/day);
BW_{child}	=	child's body weight (kg);
ED_{tot}	=	exposure duration total (years);
IRW_{adult}	=	drinking water ingestion rate of an adult (L/day); and
BW_{adult}	=	adult's body weight (kg).

The ingestion intake of COPC's in ground water for the off-site age-adjusted resident (cancer evaluation only) was estimated as follows:

$$I_w = \frac{C_w \times IFW_w \times EF \times CF}{AT}$$

where:

I_w	=	intake of COPC in drinking water (mg/kg-day);
C_w	=	concentration of COPC in ground water (µg/L);
IFW_{adj}	=	age-adjusted drinking water ingestion factor (L-year/kg-day);
EF	=	exposure frequency (days/year);
CF	=	conversion factor (1E-03 mg/µg); and
AT	=	carcinogenic averaging time (days).

9.6.1.5 Dermal Contact with Ground Water

Quantification of dermal uptake of constituents from water depends on a permeability coefficient (Kp), which describes the rate of movement of a constituent from water across the dermal barrier to the systemic circulation (USEPA, 1992). Ground water dermal uptake applies to the adult and child resident (i.e. showering/bathing). The equation for dermal uptake of chemicals from water is the same as the equation for dermal uptake of chemicals from soil. An additional equation, however, must be derived to account for the off-site age-adjusted resident for dermal exposure to inorganics in ground water (cancer evaluation). For exposure to organics in ground water (cancer evaluation), the dermal uptake equation was used to calculate exposure to the adult and child

receptors, separately, to account for the complexity of the exposure time in relation to the uptake of organic chemicals. The uptakes for the two receptors were added together to account for exposure to the adult and child during the first 30 years of life and averaged over a lifetime.

The age-adjusted water skin contact factor, SFW_{adj}, is derived by analogy to the age-adjusted soil skin contact factor as follows:

$$SFW_{adj} = \frac{ET_{child} \times ED_{child} \times SA_{child}}{BW_{child}} + \frac{ET_{adult} \times (ED_{tot} - ED_{child}) \times SA_{adult}}{BW_{adult}}$$

where:

SFW_{adj} = age-adjusted water skin contact factor (cm^2-year/kg);
ED_{child} = exposure duration, residential child (years);
SA_{child} = surface area of skin available for contact with water, residential child (cm^2);
BW_{child} = body weight, residential child (kg);
ET_{child} = exposure time, residential child (hours);
ED_{tot} = exposure duration, resident, total (years);
SA_{adult} = surface area of skin available for contact with water, residential adult (cm^2);
BW_{adult} = body weight (kg), residential adult; and
ET_{adult} = exposure time, residential adult (hours).

The age-adjusted off-site resident dermal exposure to inorganics in ground water (cancer evaluation) equation is as follows:

$$DAD = \frac{DA_{event} \times SFW_{adj} \times EF}{AT}$$

where:

DAD = dermally absorbed dose of COPC (mg/kg-day);
DA_{event} = dose absorbed per event (mg/cm^2-event);
SFW_{adj} = age-adjusted water skin contact factor (cm^2-year/kg);
EF = exposure frequency (events/year); and
AT = carcinogenic averaging time (days).

Separate calculation methods were applied to estimate DA_{event} for inorganic and organic chemicals in water. For inorganic chemicals, the average dermally absorbed dose of COPC was calculated

from:

$$DA_{event} = C_w \times Kp \times ET \times CF_1 \times CF_2$$

where:

DA_{event}	=	dose absorbed per event (mg/cm^2-event);
C_w	=	concentration of COPC in water (µg/L);
Kp	=	permeability coefficient (cm/hour);
ET	=	dermal exposure time (hours/event), noncancer evaluation only;
CF_1	=	conversion factor (0.001 L/cm^3); and
CF_2	=	conversion factor (0.001 mg/µg).

K_P has been determined for very few inorganic compounds. For those inorganic compounds for which empirical data are not available, USEPA (USEPA, 1992) recommends a default of 1E-03 cm/hour.

K_P for organic chemicals varies by several orders of magnitude (USEPA, 1992). K_P for organic chemicals is highly dependent on lipophilicity, expressed as a function of the octanol/water partition coefficient (K_{ow}). Because the stratum corneum (the outer skin layer) is rich in lipid content, it may act as a sink, initially reducing the transport of chemical to the systemic circulation. With continued exposure and the attainment of steady state conditions, the rate of dermal uptake increases. Therefore, different equations are used to estimate DA_{event}, depending on whether the exposure time is less than or greater than the estimated time to reach steady state.

When steady state has not been reached, which is the case for the receptors identified having relatively short exposure times, DA_{event} is calculated from the following equation (USEPA, 1992):

$$DA_{event} = 2 \times Kp \times C_w \times CF_1 \times CF_2 \times \sqrt{\frac{6\tau \times t}{\pi}}$$

where:

DA_{event}	=	dose absorbed per event (mg/cm^2-event);
KP	=	permeability coefficient (cm/hour);
C_w	=	concentration of constituent in water (µg/L);
CF_1	=	conversion factor (0.001 L/cm^3);
CF_2	=	conversion factor (0.001 mg/µg);

τ = chemical absorption lag time (hours); and
t_{event} = event (exposure) time (hours)

When steady state has been reached, DA_{event} is calculated from the following equation (USEPA, 1992):

$$DA_{event} = Kp \times C_w \times CF_1 \times CF_2 \times [\frac{t_{event}}{1+B} + 2 \times \tau (\frac{1+3B}{1+B})]$$

where:

DA_{event} = dose absorbed per event (mg/cm^2-event);
Kp = permeability coefficient (cm/hour);
C_w = concentration of constituent in water (µg/L);
CF_1 = conversion factor (0.001 L/cm^3);
CF_2 = conversion factor (0.001 mg/µg);
τ = chemical absorption lag time (hours);
t_{event} = event (exposure) time (hours); and
B = flux through the skin (dimension less).

The values for Kp and τ were taken from USEPA (USEPA, 1992).

9.6.1.6 Inhalation of VOC's in Ground Water

The off-site resident may be exposed to airborne VOC's released from ground water during showering/bathing and household uses. The following equation (USEPA, 1989a) was used to estimate the intake of airborne COPC's during these scenarios:

$$I = \frac{C \times IR \times ET \times EF \times ED}{BW \times AT}$$

where:

I = intake of COPC (mg/kg-day);
C = concentration of COPC in air (µg/m^3);
IR = inhalation rate (m^3/hour, or in some instances, m^3/day);
ET = exposure time (hours/day); used in shower/bath noncancer scenario;
EF = exposure frequency (days/year);

ED = exposure duration (years);
BW = body weight (kg); and
AT = averaging time (days).

The age-adjusted factor for inhalation is:

$$InhF_{adj} = \frac{ET_{child} \times ED_{child} \times IR_{child}}{BW_{child}} + \frac{ET_{adult} \times (ED_{total} - ED_{child}) \times IR_{adult}}{BW_{adult}}$$

where:

$InhF_{adj}$ = age adjusted inhalation factor (m^3-year/kg-hour, or m^3-year/kg-day where applicable);
ED_{child} = exposure duration for a child (years);
IR_{child} = inhalation rate of a child (m^3/hour, or in some instances, m^3/day);
BW_{child} = body weight of a child (kg);
ET_{child} = exposure time bathing child.
ED_{total} = exposure duration for a resident (years);
IR_{adult} = inhalation rate of an adult (m^3/hour, or in some instances, m^3/day);
BW_{adult} = body weight of an adult (kg); and
ET_{adult} = exposure time showering adult.

The age-adjusted resident inhalation intake of VOC's in ground water (cancer evaluation) risk equation is as follows:

$$I = \frac{C \times InhF_{adj} \times EF}{AT}$$

where:

I = intake of COPC (mg/kg-day);
C = concentration of COPC in air from volatilization from ground water ($\mu g/m^3$);
$InhF_{adj}$ = age-adjusted inhalation factor (m^3-year/kg-day);
EF = exposure frequency for ground water (days/year); and
AT = carcinogenic averaging time (days).

9.6.2 Receptor-Specific Intake Variables

A discussion of each of the variables used in the intake equations described in the previous section is presented in the following sections. The variables are summarized in Tables 9-7 and 9-8 .

9.6.2.1 Current/Future Off-Site Resident

The cancer assessments were based on an age-adjusted resident using USEPA default values (USEPA, 1996b). The noncancer evaluations assumed exposure to a child (more conservative evaluation than adult), as described above. The RME evaluations assumed that a 70-kg adult was exposed for 24 years (USEPA, 1991a) and a 15-kg child was exposed for 6 years (USEPA, 1991a). The USEPA default RME exposure frequency of 350 days/year (USEPA, 1991a) was used for cancer and noncancer evaluations.

The RME incidental soil ingestion factor for the age-adjusted resident is 114 mg-yrs/kg-day, which is calculated based on the USEPA default RME ingestion rates for the adult of 100 mg/day (USEPA, 1991a) and for a child of 200 mg/day (USEPA, 1991a).

The calculated drinking water ingestion factor for the age-adjusted adult resident is 1.09 L-years/kg-day, and was based on the USEPA default drinking water rates for the adult of 2 L/day and child of 1 L/day (USEPA, 1989b).

The age-adjusted water skin contact factor, SFW_{adj}, is derived by analogy to the age-adjusted inhalation and drinking water ingestion factors using the equation described in Section 9.6.1.5. The average total adult body surface area is approximately 20,000 cm^2 (USEPA, 1992). The average total body surface area for children ages 2 to 6 years is estimated at 7,300 cm^2 (USEPA, 1992), which was adopted as the surface area of the skin available for contact with water in a bathing scenario. From the equation above and exposure durations defined earlier for the adult resident, an RME age-adjusted water skin contact factor of 3,561 cm^2-year/kg was estimated. The total exposure time in the shower room for the adult was 12 minutes (USEPA, 1989b). The total exposure time in the bath for the child was 45 minutes (USEPA, 1989b).

The age-adjusted soil skin contact factor, SFS_{adj}, was calculated in a similar manner. The RME value of 2,720 cm^2-yr/kg was calculated using the RME exposure durations and body weights given above and a surface area of 5,800 cm^2 for the adult (USEPA, 1992) and a surface area of 1,825 cm^2 for the child. The child surface area is calculated as 25% of the mean total surface for a male child aged 2-6 years (USEPA, 1992).

The RME inhalation factor for determining the risk of inhalation of VOC's from ground water while showering/bathing for the age-adjusted resident was calculated using the algorithm provided by USEPA (USEPA, 1996b), the exposure durations defined above, an exposure time of 12 minutes for a showering adult and 45 minutes for a bathing child (USEPA, 1997b), and an inhalation rate

of 0.6 m^3/hour for both the adult and child (USEPA, 1989b). The concentration in air, calculated using the Andelman model, for the age-adjusted resident assumed an adjusted time of approximately 30 minutes.

The RME inhalation factor for determining the risk of inhalation of VOC's from ground water in indoor air from household uses for the age-adjusted resident was also calculated using the algorithm provided by USEPA (USEPA, 1996b), the exposure durations defined above, and an inhalation rate of 30 m^3/day for the adult, and 20 m^3/day for the child (USEPA, 1989b).

9.6.2.2 Current and Future Off-Site Resident Gardener

The majority of the exposure parameters used for the off-site resident gardener are identical to those used for the off-site resident. The only instances where the resident and resident-gardener parameters differ are: 1) the adult soil ingestion rate, 480 mg/day, is recommended for adults engaged in outdoor activities (USEPA, 1997b), and 2) the exposure frequency for gardening activities for both adults and children is 40 days/year (USEPA, 1997b).

9.6.2.3 Current and Future Off-Site Construction Worker

A current and future off-site construction worker was defined as an individual who works in the CDA near the Himco Dump Site, and is involved in resident home improvement construction projects. Therefore, individuals assigned to short-term intrusive construction projects needed to be evaluated. The construction worker was assumed to be an average adult with a body weight of 70 kg who was exposed to site elements approximately 5 days per work week for 9 months, or 180 days (with 10 days of inclement weather). It is likely that a construction worker would work at the site 180 days/year for approximately 9 months for a home-improvement construction project. An incidental soil ingestion rate of 480 mg/day was based on adult ingestion of soil and dust engaged in outdoor activities (USEPA, 1997b). The fraction of exposure attributed to site soil ingestion was assumed to be 1. Finally, a respiratory rate of 20 m^3/day was used (USEPA 1991a).

Clothing provides protection against dermal contact with soil, restricting potential contact largely to the head, hands, and forearms; therefore, the available surface area for dermal contact was estimated to be 2,000 cm^2, which is the central tendency for outdoor soil contact (USEPA, 1997b). Based on studies cited in the *Dermal Exposure Assessment: Principles and Applications* (USEPA, 1992), a default soil adherence factor of 1.0 mg/cm^2 was used (for all receptors) as an upper bound value.

9.7 Toxicity Assessment

The most current available toxicity data (RfD or CSF) were used to calculate carcinogenic and noncarcinogenic risks/hazards, including the most recent Integrated Risk Information System (IRIS) (USEPA, 2000c) updates and Health Effects Assessment Summary Table (HEAST) values (USEPA,

1997a). Provisional toxicity values provided by USEPA were also used as appropriate. Toxicity assessment for carcinogenic PAHs was performed with Toxicity Equivalency Factor (TEF) methodology relative to that of benzo(a)pyrene (USEPA, 1993). Toxicity values and additional physical and chemical values for all COPC's are listed in Table 9-9. In addition, toxicity profiles for the main chemicals are included in Appendix M.

Oral and inhalation toxicity values provided by USEPA reflect administered-dose values, that is they represent concentrations that will be protective following ingestion or inhalation. The dermal route of exposure, however, evaluates the toxicity of concentrations of chemicals in the blood (absorbed). Therefore, the absorbed-dose concentrations identified for dermal exposure must be compared to absorbed-dose toxicity values. The absorbed-dose toxicity values are derived by applying (multiplying) gastrointestinal absorption factors (GAF's) to administered-dose toxicity values. USEPA (Dan Stralka, Region 9, personal communication) recommends adjustment of the oral toxicity value when the (GAF) is less than 0.5. Default GAF's of 10 percent for organics and 1 percent for inorganics were used if literature values were unavailable.

9.8 Risk Characterization

To characterize potential noncarcinogenic effects, comparisons were made between projected intakes of substances and toxicity values. To characterize potential carcinogenic effects, the incremental probability of an individual developing cancer over a lifetime was calculated from projected intakes and chemical-specific dose-response information. For each COPC having available toxicity values, a cancer risk (for carcinogenic risk) and/or hazard quotient (HQ) (for noncancer risk) estimate was calculated. The methods used to estimate risk/hazard and the carcinogenic and noncarcinogenic results (including risk summaries by pathway and receptor for current and future receptors) are presented herein.

9.8.1 Carcinogenic Effects

Carcinogenic risk is expressed as an increased probability of developing cancer as a result of lifetime exposure. For a given chemical and route of exposure, carcinogenic risk is calculated as follows:

$$\text{Risk} = \text{Intake} \times \text{CSF}$$

For simultaneous exposure to several carcinogens or routes of exposure, cumulative risk is calculated using the following information.

$$\text{Risk}_T = \text{Risk}_1 + \text{Risk}_2 + ... + \text{Risk}i$$

where:

$Risk_T$ = the total cancer risk, expressed as a unitless probability, and

$Risk_i$ = the risk estimate for the *i*th substance.

USEPA considers that the simultaneous exposures to low doses of mixtures of chemical carcinogens may result in synergistic or antagonistic effects or some combination of both; however, due to the lack of data on the effects of mixtures, USEPA simply uses an additive approach, unless data are available on the effect of the mixtures of interest.

9.8.2 Noncarcinogenic Effects

The potential for noncarcinogenic effects was evaluated by comparing an exposure level or intake (chronic daily intake, or CDI) over a specified time period with a reference dose (RfD) derived for a similar exposure period. This ratio is termed the HQ. In other words, the HQ equals the intake divided by the reference value, or:

Noncarcinogenic HQ = intake/RfD

The HQ assumes that there is a level of exposure (i.e., RfD) below which it is unlikely for even sensitive populations to experience adverse health effects. If the exposure level exceeds the threshold (i.e., if HQ exceeds unity), there may be a concern for potential noncancer effects.

To assess the overall potential for noncarcinogenic effects posed by more than one chemical or route of exposure, a hazard index (HI) approach has been developed by USEPA (USEPA, 1989a). This approach assumes that simultaneous sub-threshold exposures to several chemicals could result in an adverse health effect, while acting on the same target organ. The HI is calculated as follows:

$$HI = HQ_1 + HQ_2 + ... + HQ_i$$

where:

HQ_i = the hazard quotient for the *i*th toxicant.

It should be noted that exposure intake is taken to mean "chronic" exposure. Chronic exposure is defined as exposure that occurs over at least 7 years (USEPA, 1989a).

9.8.3 Results of Risk Characterization for the CDA

The pathway-specific and cumulative cancer risks and noncancer hazards for the receptors quantitatively evaluated are summarized in Tables 9-10 through 9-20. Calculations supporting these risk/hazard results are located in Appendix K.

9.8.3.1 Himco CDA Land Parcel M Site-Related Chemical Risk Characterization-Carcinogens

For Land Parcel M, the estimated risk for the adult resident is 3.3 in 10,000 (3.3E-04). The only other applicable receptor evaluated for site-related risk at Land Parcel M was the construction worker whose risk is 2.7 in 10,000,000 (2.7E-07). The adult resident scenario for Land Parcel M is discussed in greater detail below.

Table 9-11 provides a risk summary for soil site risk that includes chemical- and pathway-specific risk estimates for each applicable scenario; and, total site risk. Table 9-10 provides a risk summary for ground water site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative risk values are the sums associated with all carcinogenic COPC's that were detected at the Himco CDA.

Adult Resident - The estimated risk for an age-adjusted adult resident at Land Parcel M is 3.3 in 10,000 (3.3E-04). This cumulative site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil risk for an adult resident at Land Parcel M for this scenario is 3.0 in 100,000 (3.0E-05). This risk is based on the adult resident's exposure to surface soils (0-0.5 ft) which is estimated to be 2.6 in 100,000 (2.6E-05), and exposure to 0-2 ft soils [4.1 in 1,000,000 (4.1E-06)] while gardening. The site-related soil risk estimate is due to dermal exposure of surface soil [1.7 in 100,000 (1.7E-05)] and attributable predominantly to arsenic, benzo(a)pyrene, and dibenz(a,h)anthracene.

9.8.3.2 Himco CDA Land Parcel M Site-Related Chemical Risk Characterization--Noncarcinogens

For Land Parcel M, the estimated total media risk for the child resident is a hazard index of 46. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative assessment. The only other applicable receptor evaluated for site-related noncancer risk at Land Parcel M was the construction worker with an HI of 0.11. The child resident scenario for Land Parcel M is discussed in greater detail below.

Table 9-11 provides a hazard summary for soil that includes chemical- and pathway-specific hazard estimates for each applicable scenario. Table 9-10 provides a summary for ground water site hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at the Himco CDA.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at Land Parcel M is a hazard index of 46. This cumulative site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil noncancer risk estimate for a child resident (the most conservative assumption) at Land Parcel M has an HI of 0.50.

9.8.3.3 Himco CDA Land Parcel O Site-Related Chemical Risk Characterization-Carcinogens

For Land Parcel O, the estimated risk for the adult resident is 3.3 in 10,000 (3.3E-04). The only other applicable receptor evaluated for site-related risk at Land Parcel O was the construction worker whose risk is 3.3 in 10,000,000 (3.3E-07). The adult resident scenario for Land Parcel O is discussed in greater detail below.

Table 9-12 provides a risk summary for soil site risk that includes chemical- and pathway-specific risk estimates for each applicable scenario. Table 9-10 provides a risk summary for ground water site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative risk values are the sums associated with all carcinogenic COPC's that were detected at the Himco CDA.

Adult Resident - The estimated risk for an age-adjusted adult resident at Land Parcel O is 3.3 in 10,000 (3.3E-04). This site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil risk for an adult resident at Land Parcel O for this scenario is 3.2 in 100,000 (3.2E-05). The risk is based on the adult resident's exposure to surface soils (0-0.5 ft) which is estimated to be 2.8 in 100,000 (2.8E-05), and exposure to 0-2 ft soils [4.5 in 1,000,000 (4.5E-06)] while gardening. This site-related soil risk estimate is due to ingestion of and dermal contact with surface soil and attributable predominantly to arsenic, benzo(a)pyrene, and dibenz(a,h)anthracene.

9.8.3.4 Himco CDA Land Parcel O Site-Related Chemical Risk Characterization--Noncarcinogens

For Land Parcel O, the estimated total media risk for the child resident is a hazard index of 47. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative assessment. The only other applicable receptor evaluated for site-related noncancer risk at Land Parcel O was the construction worker with an HI of 0.17. The child resident scenario for Land Parcel O is discussed in greater detail below.

Table 9-12 provides a hazard summary for soil that includes chemical- and pathway-specific hazard estimates for each applicable scenario. Table 9-10 provides a summary for ground water site hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and

pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at the Himco CDA.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at Land Parcel O is a hazard index of 47. This cumulative site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil noncancer risk estimate for a child resident (the most conservative assumption) at Land Parcel O has an HI of 0.76.

9.8.3.5 Himco CDA Land Parcel N

In the field investigation characterizing CDA soils, no soil samples were taken in Land Parcel N. Since soil samples were taken at nearby locations, USACE Omaha District and the USACE Hazardous, Toxic and Radioactive Waste Center of Expertise conducted a geostatistical analysis in order to estimate soil concentrations in Land Parcel N to be used in the risk assessment. For the resident, estimated soil risks in other land parcels within the CDA appears to be driven by arsenic and benzo(a)pyrene. Therefore, the geostatistical analysis focused on deriving arsenic and benzo(a)pyrene concentrations. The locations and sample results for arsenic and benzo(a)pyrene for the 18 Himco CDA soil borings were compiled. Values for the 0-0.5 ft samples were used as reported. Values for the 0.5-2, 2-4 and 4-6 ft samples, if available, were averaged for each borehole to account for inconsistent sampling at these depths. The data was then analyzed using the Geo-Eas software from USEPA. Although the geostatistical analysis allowed the evaluation of Land Parcel N, there is uncertainty in assuming soil concentrations in surrounding land parcels can be projected into Land Parcel N given that the construction debris material is not homogeneous. For a detailed description of the geostatistical analysis and the derived arsenic and benzo(a)pyrene concentrations for Land Parcel N, refer to Appendix L.

Based upon how the data were compiled for the geostatistical analysis, the maximum derived arsenic or benzo(a)pyrene concentrations were chosen from all derived Land Parcel N concentrations as the exposure point concentrations in the quantitative risk assessment. The maximum concentration of arsenic or benzo(a)pyrene was detected in the 0-0.5 ft depth; therefore, was used by default for the child and adult resident/gardener, and the construction worker scenarios.

9.8.3.6 Himco CDA Land Parcel N Site-Related Chemical Risk Characterization-Carcinogens

For Land Parcel N, the estimated risk for the adult resident is 3.2 in 10,000 (3.2E-04). The only other applicable receptor evaluated for site-related risk at Land Parcel N was the construction worker whose risk to arsenic and benzo(a)pyrene is 1.9 in 10,000,000 (1.9E-07). The adult resident scenario for Land Parcel N is discussed in greater detail below.

Table 9-13 provides a risk summary for soil site risk that includes chemical- and pathway-specific risk estimates for arsenic and benzo(a)pyrene for each applicable scenario. Table 9-10 provides a risk summary for ground water site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative risk values are the sums associated with all carcinogenic COPC's that were detected at the Himco CDA.

Adult Resident - The estimated risk for an age-adjusted adult resident at Land Parcel N is 3.2 in 10,000 (3.2E-04). This cumulative site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil risk for arsenic and benzo(a)pyrene for an adult resident at Land Parcel N for this scenario is 1.9 in 100,000 (1.9E-05). The risk is based on the adult resident's exposure to 0-0.5 ft soils which is estimated to be 1.6 in 100,000 (1.6E-05), and exposure to 0-2 ft soils [2.7 in 1,000,000 (2.7E-06)] while gardening. This site-related soil risk estimate is due predominately to ingestion of and dermal contact with soils.

9.8.3.7 Himco CDA Land Parcel N Site-Related Chemical Risk Characterization--Noncarcinogens

For Land Parcel N, the estimated total media risk for the child resident is a hazard index of 46. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative assessment. The only other applicable receptor evaluated for site-related noncancer risk at Land Parcel N was the construction worker with an HI of 0.02. The child resident scenario for Land Parcel N is discussed in greater detail below.

Table 9-13 provides a hazard summary for soil that includes chemical- and pathway-specific hazard estimates for arsenic for each applicable scenario. Table 9-10 provides a summary for ground water site hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at the Himco CDA.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at Land Parcel N is a hazard index of 46. This site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil noncancer risk estimate for a child resident (the most conservative assumption) at Land Parcel N has an HI of 0.11.

9.8.3.8 Himco CDA Land Parcel P Site-Related Chemical Risk Characterization-Carcinogens

For Land Parcel P, the estimated risk for the adult resident is 3.3 in 10,000 (3.3E-04). The only other applicable receptor evaluated for site-related risk at Land Parcel P was the construction worker whose risk is 2.6 in 10,000,000 (2.6E-07). The adult resident scenario for Land Parcel P is discussed in greater detail below.

Table 9-14 provides a risk summary for soil site risk that includes chemical- and pathway-specific risk estimates for each applicable scenario. Table 9-10 provides a risk summary for ground water site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative total risk values are the sums associated with all carcinogenic COPC's that were detected at the Himco CDA.

Adult Resident - The estimated risk for an age-adjusted adult resident at Land Parcel P is 3.3 in 10,000 (3.3E-04). This site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil risk for an adult resident at Land Parcel P for this scenario is 2.9 in 100,000 (2.9E-05). The risk is based on the adult resident's exposure to surface soils (0-0.5 ft) which is estimated to be 2.5 in 100,000 (2.5E-05), and exposure to 0-2 ft soils [4.0 in 1,000,000 (4.0E-06)] while gardening. This site-related soil risk estimate is due to ingestion of and dermal contact with surface soil and attributable predominantly to arsenic, benzo(a)pyrene, and dibenz(a,h)anthracene.

9.8.3.9 Himco CDA Land Parcel P Site-Related Chemical Risk Characterization-Noncarcinogens

For Land Parcel P, the estimated total media risk for the child resident is a hazard index of 47. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative assessment. The only other applicable receptor evaluated for site-related noncancer risk at Land Parcel P was the construction worker with an HI of 0.15. The child resident scenario for Land Parcel P is discussed in greater detail below.

Table 9-14 provides a hazard summary for soil that includes chemical- and pathway-specific hazard estimates for each applicable scenario. Table 9-10 provides a summary for ground water site hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative total risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at the Himco CDA.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at Land Parcel P is a hazard index of 47. This cumulative site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil noncancer risk estimate for a child resident (the most conservative assumption) at Land Parcel P has an HI of 0.71.

9.8.3.10 Himco CDA Land Parcel S Site-Related Chemical Risk Characterization-Carcinogens

For Land Parcel S, the estimated risk for the adult resident is 4.1 in 10,000 (4.1E-04). The only other applicable receptor evaluated for site-related risk at Land Parcel S was the construction worker whose cumulative risk is 1.7 in 1,000,000 (1.7E-06). The adult resident scenario and the construction worker scenario for Land Parcel S are discussed in greater detail below.

Table 9-15 provides a risk summary for soil site risk that includes chemical- and pathway-specific risk estimates for each applicable scenario. Table 9-10 provides a risk summary for ground water site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative total risk values are the sums associated with all carcinogenic COPC's that were detected at the Himco CDA.

Adult Resident - The estimated risk for an age-adjusted adult resident at Land Parcel S is 4.1 in 10,000 (4.1E-04). This cumulative site hazard risk is due to exposure to both soil and ground water. Exposure to ground water will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil risk for an adult resident at Land Parcel S for this scenario is 1.1 in 10,000 (1.1E-04). The risk is based on the adult resident's exposure to surface soils (0-0.5 ft) which is estimated to be 8.6 in 100,000 (8.6E-05), and exposure to 0-2 ft soils [2.4 in 100,000 (2.4E-05)] while gardening. This site-related soil risk estimate is due to ingestion of and dermal contact with surface soils and attributable predominantly to arsenic and benzo(a)pyrene.

Construction Worker - The estimated soil risk for a construction worker at Land Parcel S for this scenario is 1.7 in 1,000,000 (1.7E-06). The risk is based on the construction worker's ingestion of surface and subsurface soils (0-6 ft), and is attributable to ingestion of arsenic and benzo(a)pyrene.

9.8.3.11 Himco CDA Land Parcel S Site-Related Chemical Risk Characterization--Noncarcinogens

For Land Parcel S, the estimated total media risk for the child resident is a hazard index of 49. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative. The only other applicable receptor evaluated for site-related noncancer risk at Land Parcel S was the construction worker with an HI of 0.61. The child resident scenario for Land Parcel S is discussed in greater detail below.

Table 9-15 provides a hazard summary for soil that includes chemical- and pathway-specific hazard estimates for each applicable scenario. Table 9-10 provides a summary for ground water site

hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative total risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at the Himco CDA.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at Land Parcel S is a hazard index of 49. This site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil noncancer risk estimate for a child resident (the most conservative assumption) at Land Parcel S has an HI of 2.9. This site-related soil hazard estimate is due to ingestion of surface soil (0-0.5 ft) (HI of 2.6) and attributable to a total exposure of detected metals (antimony, arsenic, copper, and manganese). However, when the total Land Parcel S HI is separated by target organ [(i.e. antimony-blood and arsenic-skin, manganese-CNS (Central Nervous System)], there are no unacceptable HI's.

9.8.3.12 Himco CDA Land Parcel T Site-Related Chemical Risk Characterization-Carcinogens

As with Land Parcel N, a geostatistical analysis was also conducted for Land Parcel T. A detailed description of the derived concentrations is presented in Appendix L. For Land Parcel T, the estimated risk for the adult resident is 3.4 in 10,000 (3.4E-04). The only other applicable receptor evaluated for site-related risk at Land Parcel T was the construction worker whose cumulative risk is 4.6 in 10,000,000 (4.6E-07). The adult resident scenario and the construction worker scenario for Land Parcel T are discussed in greater detail below.

Table 9-16 provides a risk summary for soil site risk that includes chemical- and pathway-specific risk estimates for each applicable scenario. Table 9-10 provides a risk summary for ground water site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative total risk values are the sums associated with all carcinogenic COPC's that were detected at the Himco CDA.

Adult Resident - The estimated risk for an age-adjusted adult resident at Land Parcel T is 3.4 in 10,000 (3.4E-04). This cumulative site hazard risk is due to exposure to both soil and ground water. Exposure to ground water will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil risk for an adult resident at Land Parcel T for this scenario is 4.2 in 100,000 (4.2E-05). The risk is based on the adult resident's exposure to surface soils (0-0.5 ft) which is estimated to be 3.6 in 100,000 (3.6E-05), and exposure to 0-2 ft soils [6.2 in 1,000,000 (6.2E-06)] while gardening. This site-related soil risk estimate is due to ingestion of and dermal contact with surface soils and attributable predominantly to arsenic and benzo(a)pyrene.

Construction Worker - The estimated soil risk for a construction worker at Land Parcel T for this scenario is 4.6 in 10,000,000 (4.6E-07). The risk is based on the construction worker's ingestion of surface and subsurface soils (0-6 ft), and is attributable to ingestion of arsenic and benzo(a)pyrene.

9.8.3.13 Himco CDA Land Parcel T Site-Related Chemical Risk Characterization--Noncarcinogens

For Land Parcel T, the estimated total media risk for the child resident is a hazard index of 46. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative. The only other applicable receptor evaluated for site-related noncancer risk at Land Parcel T was the construction worker with an HI of 0.07. The child resident scenario for Land Parcel T is discussed in greater detail below.

Table 9-16 provides a hazard summary for soil that includes chemical- and pathway-specific hazard estimates for each applicable scenario. Table 9-10 provides a summary for ground water site hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative total risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at the Himco CDA.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at Land Parcel T is a hazard index of 46. This site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil noncancer risk estimate for a child resident (the most conservative assumption) at Land Parcel T has an HI of 0.31. This site-related soil hazard estimate is due to ingestion of surface soil (0-0.5 ft) and attributable to a total exposure of arsenic.

9.8.3.14 Himco CDA Land Parcel Q Site-Related Chemical Risk Characterization-Carcinogens

As with Land Parcel N, a geostatistical analysis was also conducted for Land Parcel Q. A detailed description of the derived concentrations is presented in Appendix L. For Land Parcel Q, the estimated risk for the adult resident is 3.9 in 10,000 (3.9E-04). The only other applicable receptor evaluated for site-related risk at Land Parcel Q was the construction worker whose cumulative risk is 9.0 in 10,000,000 (9.0E-07). The adult resident scenario and the construction worker scenario for Land Parcel Q are discussed in greater detail below.

Table 9-17 provides a risk summary for soil site risk that includes chemical- and pathway-specific risk estimates for each applicable scenario. Table 9-10 provides a risk summary for ground water site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and

pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative total risk values are the sums associated with all carcinogenic COPC's that were detected at the Himco CDA.

Adult Resident - The estimated risk for an age-adjusted adult resident at Land Parcel Q is 3.9 in 10,000 (3.9E-04). This cumulative site hazard risk is due to exposure to both soil and ground water. Exposure to ground water will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil risk for an adult resident at Land Parcel Q for this scenario is 8.6 in 100,000 (8.6E-05). The risk is based on the adult resident's exposure to surface soils (0-0.5 ft) which is estimated to be 7.4 in 100,000 (7.4E-05), and exposure to 0-2 ft soils [1.3 in 100,000 (1.3E-05)] while gardening. This site-related soil risk estimate is due to ingestion of and dermal contact with surface soils and attributable predominantly to arsenic and benzo(a)pyrene.

Construction Worker - The estimated soil risk for a construction worker at Land Parcel Q for this scenario is 9.0 in 10,000,000 (9.0E-07). The risk is based on the construction worker's ingestion of surface and subsurface soils (0-6 ft), and is attributable to ingestion of arsenic and benzo(a)pyrene.

9.8.3.15 Himco CDA Land Parcel Q Site-Related Chemical Risk Characterization--Noncarcinogens

For Land Parcel Q, the estimated total media risk for the child resident is a hazard index of 47. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative. The only other applicable receptor evaluated for site-related noncancer risk at Land Parcel Q was the construction worker with an HI of 0.13. The child resident scenario for Land Parcel Q is discussed in greater detail below.

Table 9-17 provides a hazard summary for soil that includes chemical- and pathway-specific hazard estimates for each applicable scenario. Table 9-10 provides a summary for ground water site hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative total risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at the Himco CDA.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at Land Parcel Q is a hazard index of 47. This site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil noncancer risk estimate for a child resident (the most conservative assumption) at Land Parcel Q has an HI of 0.59.

9.8.3.16 Himco CDA Land Parcel R Site-Related Chemical Risk Characterization-Carcinogens

As with Land Parcel N, a geostatistical analysis was also conducted for Land Parcel R. A detailed description of the derived concentrations is presented in Appendix L. For Land Parcel R, the estimated risk for the adult resident is 3.5 in 10,000 (3.5E-04). The only other applicable receptor evaluated for site-related risk at Land Parcel R was the construction worker whose cumulative risk is 4.6 in 10,000,000 (4.6E-07). The adult resident scenario and the construction worker scenario for Land Parcel R are discussed in greater detail below.

Table 9-18 provides a risk summary for soil site risk that includes chemical- and pathway-specific risk estimates for each applicable scenario. Table 9-10 provides a risk summary for ground water site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative total risk values are the sums associated with all carcinogenic COPC's that were detected at the Himco CDA.

Adult Resident - The estimated risk for an age-adjusted adult resident at Land Parcel R is 3.5 in 10,000. This cumulative site hazard risk is due to exposure to both soil and ground water. Exposure to ground water will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil risk for an adult resident at Land Parcel R for this scenario is 4.6 in 100,000 (4.6E-05). The risk is based on the adult resident's exposure to surface soils (0-0.5 ft) which is estimated to be 3.9 in 100,000 (3.9E-05), and exposure to 0-2 ft soils [6.5 in 1,000,000 (6.5E-06)] while gardening. This site-related soil risk estimate is due to ingestion of and dermal contact with surface soils and attributable predominantly to arsenic and benzo(a)pyrene.

Construction Worker - The estimated soil risk for a construction worker at Land Parcel R for this scenario is 4.6 in 10,000,000 (4.6E-07). The risk is based on the construction worker's ingestion of surface and subsurface soils (0-6 ft), and is attributable to ingestion of arsenic and benzo(a)pyrene.

9.8.3.17 Himco CDA Land Parcel R Site-Related Chemical Risk Characterization--Noncarcinogens

For Land Parcel R, the estimated total media risk for the child resident is a hazard index of 46. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative. The only other applicable receptor evaluated for site-related noncancer risk at Land Parcel R was the construction worker with an HI of 0.06. The child resident scenario for Land Parcel R is discussed in greater detail below.

Table 9-18 provides a hazard summary for soil that includes chemical- and pathway-specific hazard estimates for each applicable scenario. Table 9-10 provides a summary for ground water site

hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative total risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at the Himco CDA.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at Land Parcel R is a hazard index of 46. This site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil noncancer risk estimate for a child resident (the most conservative assumption) at Land Parcel R has an HI of 0.27.

9.8.3.18 Himco CDA Land Parcel F Site-Related Chemical Risk Characterization-Carcinogens

For Land Parcel F, the estimated risk for the adult resident is 4.5 in 10,000 (4.5E-04). The only other applicable receptor evaluated for site-related risk at Land Parcel F was the construction worker whose risk is 7.1 in 1,000,000 (7.1E-06). The adult resident scenario and the construction worker scenario for Land Parcel F are discussed in greater detail below.

Table 9-19 provides a risk summary for soil site risk that includes chemical- and pathway-specific risk estimates for each applicable scenario. Table 9-10 provides a risk summary for ground water site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative total risk values are the sums associated with all carcinogenic COPC's that were detected at the Himco CDA.

Adult Resident - The estimated risk for an age-adjusted adult resident at Land Parcel F is 4.5 in 10,000 (4.5E-04). This cumulative site hazard risk is due to exposure to both soil and ground water. Exposure to ground water will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil risk for an adult resident at Land Parcel F for this scenario is 1.5 in 10,000 (1.5E-04). The risk is based on the adult resident's exposure to surface soils (0-0.5 ft) which is estimated to be 1.2 in 10,000 (1.2E-04), and exposure to 0-2 ft soils [2.7 in 100,000 (2.7E-05)] while gardening. This site-related soil risk estimate is due to ingestion of and dermal contact with surface soils and attributable to arsenic, benzo(a)pyrene, and dibenz(a,h)anthracene.

Construction Worker - The estimated soil risk for a construction worker at Land Parcel F for this scenario is 7.1 in 1,000,000 (7.1E-06). The risk is based on the construction worker's ingestion of and dermal contact with surface and subsurface soils (0-6 ft), and is attributable to the ingestion of arsenic, benzo(a)pyrene, and dibenz(a,h)anthracene; and dermal contact with benzo(a)pyrene.

9.8.3.19 Himco CDA Land Parcel F Site-Related Chemical Risk Characterization--Noncarcinogens

For Land Parcel F, the estimated total media risk for the child resident is a hazard index of 50. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative assessment. The only other applicable receptor evaluated for site-related noncancer risk at Land Parcel F was the construction worker with an HI of 1.3. The child resident and construction worker scenario for Land Parcel F is discussed in greater detail below.

Table 9-19 provides a hazard summary for soil that includes chemical- and pathway-specific hazard estimates for each applicable scenario. Table 9-10 provides a summary for ground water site hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative total risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at the Himco CDA.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at Land Parcel F is a hazard index of 50. This cumulative site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil noncancer risk estimate for a child resident (the most conservative assumption) at Land Parcel F has an HI of 4.5. This site-related soil hazard estimate is attributable predominantly to ingestion of and dermal contact with mercury in surface soil (0-0.5 ft). The HI for mercury in surface soil is 2.7.

Construction Worker - The estimated soil noncancer risk estimate for a construction worker at Land Parcel F is an HI of 1.3. The soil risk hazard estimate is due to exposure to surface and subsurface soils (0-6 ft) and attributable predominantly to ingestion of and dermal contact with metals; arsenic, manganese and mercury. However, the individual HI values for the respective target organs for these metals are less than 1; arsenic-skin (0.14) and manganese/mercury-CNS (0.74).

9.8.3.20 Himco CDA Land Parcel D Site-Related Chemical Risk Characterization-Carcinogens

For Land Parcel D, the estimated risk for the adult resident is 3.6 in 10,000 (3.6E-04). The only other applicable receptor evaluated for site-related risk at Land Parcel D was the construction worker whose risk is 1.3 in 1,000,000 (1.3E-06). The adult resident scenario and the construction worker scenario for Land Parcel D are discussed in greater detail below.

Table 9-20 provides a risk summary for soil site risk that includes chemical- and pathway-specific risk estimates for each applicable scenario. Table 9-10 provides a risk summary for ground water

site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative risk values are the sums associated with all carcinogenic COPC's that were detected at the Himco CDA.

Adult Resident - The estimated risk for an age-adjusted adult resident at Land Parcel D is 3.6 in 10,000 (3.6E-04). This site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil risk for an adult resident at Land Parcel D for this scenario is 6.4 in 100,000 (6.4E-05). The risk is based on the adult resident's exposure to surface soils (0-0.5 ft) which is estimated to be 4.5 in 100,000 (4.5E-05), and exposure to 0-2 ft soils [2.0 in 100,000 (2.0E-05)] while gardening. This site-related soil risk estimate is due to ingestion of and dermal contact with surface soils and attributable to arsenic, benzo(a)pyrene, and dibenz(a,h)anthracene.

Construction Worker - The estimated soil risk for a construction worker at Land Parcel D for this scenario is 1.3 in 1,000,000 (1.3E-06). The risk is based on the construction worker's ingestion of surface and subsurface soils (0-6 ft), and is attributable to the ingestion of arsenic and benzo(a)pyrene.

9.8.3.21 Himco CDA Land Parcel D Site-Related Chemical Risk Characterization--Noncarcinogens

For Land Parcel D, the estimated media risk for the adult/child resident is a hazard index of 47. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative assessment. The only other applicable receptor evaluated for site-related noncancer risk at Land Parcel D was the construction worker with an HI of 0.26. The child resident scenario for Land Parcel D is discussed in greater detail below.

Table 9-20 provides a hazard summary for soil that includes chemical- and pathway-specific hazard estimates for each applicable scenario. Table 9-10 provides a summary for ground water site hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative total risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at the Himco CDA.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at Land Parcel D is a hazard index of 47. This site hazard risk is predominately due to exposure to ground water and will be explained in further detail in Sections 9.8.3.21 and 9.8.3.22.

The estimated soil noncancer risk estimate for a child resident (the most conservative assumption) at Land Parcel D has an HI of 0.97.

9.8.3.22 Downgradient Ground Water Well Locations: Well-Pair WT116A/WT119A Hypothetical Exposure Location Chemical Risk Characterization-Carcinogens

For well-pair WT116A/WT119A ground water hypothetical exposure location (the individual residential parcel risk for groundwater is based upon data from this well-pair; this well-pair is in close proximity to the parcels of land being evaluated), the estimated risk for the adult resident is 3.0 in 10,000 (3.0E-04). The adult resident scenario for this exposure location is discussed in greater detail below.

Table 9-10 provides a risk summary for ground water site risk for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific risk estimates for each applicable scenario. The Subtotal and Cumulative total risk values are the sums associated with all carcinogenic COPC's that were detected at this location at the Himco Dump Site.

Adult Resident - The estimated ground water risk for an age-adjusted adult resident at hypothetical exposure location WT116A/WT119A is 3.0 in 10,000 (3.0E-04). The risk is based on: 1) ingestion of arsenic, benzene, and vinyl chloride [1.8 in 10,000 (1.8E-04)], and 2) inhalation exposure to benzene [1.0 in 10,000 (1.0E-04)]; during household use.

9.8.3.23 Downgradient Ground Water Well Locations: Well-Pair WT116A/WT119A Hypothetical Exposure Location Chemical Risk Characterization--Noncarcinogens

For well-pair WT116A/WT119A ground water hypothetical exposure location (the individual residential parcel risk for groundwater is based upon data from this well-pair), the estimated noncancer risk for the child resident is a hazard index of 46. The child resident scenario was evaluated for all noncarcinogenic media hazards, because it is the most conservative assessment. The child resident scenario for well-pair WT116A/WT119A exposure location is discussed in greater detail below.

Table 9-10 provides a summary for ground water site hazards for well-pair WT116A/WT119A hypothetical exposure location that includes chemical- and pathway-specific hazard summary estimates for each applicable scenario. The Subtotal and Cumulative risk numbers include the hazards associated with all noncarcinogenic COPC's that were detected at this location at the Himco Dump Site.

Child Resident - The estimated total noncancer hazard risk estimate for a child resident at well-pair WT116A/WT119A hypothetical exposure location is a hazard index of 46. This site risk is predominately due to 1) the child's inhalation exposure to benzene and 1,2-dichloropropane (HI = 22), and 2) the child's ingestion of antimony, arsenic, iron, manganese, and thallium (HI = 22). When the total HI from exposure to ground water is separated by target organ [(i.e. arsenic-skin, iron-liver, manganese-CNS (Central Nervous System), antimony, thallium, and benzene-blood, and

1,2-Dichloropropane-respiratory], all of the target organ HI's exceed an HI of 1.0.

9.9 Uncertainty Analysis

Many factors contribute to uncertainty in the risk estimates provided in this assessment, including uncertainties associated with media concentrations and assumptions regarding receptor exposure, as well as individual variability. Uncertainty and variability can result in risk estimates being over-estimated or under-estimated, even when risk parameters are set to a conservative level to reduce the potential for under-estimation of site risks. Uncertainty in media concentrations can usually be reduced by increased data collection, as it is impacted by factors such as selection of sampling locations, number of samples collected, analytical methods and errors, representativeness of the data, and such. Uncertainty introduced in the assumptions regarding receptor behavior can often be reduced by observing receptor activities, conducting surveys and interviewing receptors, especially when default values are used to characterize exposure activities. Variability, which includes individual variability in behavior that affects contact with contaminated media, differences in absorption and metabolism of contaminants, and differences in health status which affect health outcomes that may occur with exposure, can not usually be reduced. Identifying and discussing the major sources of uncertainty and their effect on the risk estimates allows for better interpretation of the results and decisions as to whether the uncertainties can be reduced (e.g., by collection of more data).

The primary sources of uncertainty specific to this assessment which are likely to have impact on the risk estimates are identified in Table 9-21 and are briefly summarized below:

9.9.1 Sampling Design

Soils - Sampling of soils in the Himco CDA was limited to 18 soil borings advanced in 6 parcels, and four parcels were not sampled. Kriging, a geostatistical procedure to estimate concentrations in areas not sampled, was used to establish concentrations of two contaminants (arsenic and benzo(a)pyrene, the carcinogenic risk drivers in the sampled parcels) in the parcels not sampled. Not all chemicals detected in the soils at the CDA were modeled using this procedure, which will likely underestimate risks in the non-sampled parcels. Basing contaminant concentrations on such a limited data base may over- or underestimate the actual concentrations available for exposure, as sampling may not have found all contaminants or the highest contaminant concentrations. Additionally, use of kriging to estimate concentrations may over- or underestimate actual concentrations in the areas not sampled, however, the calculated variances would indicate that the projected concentrations are reasonable for arsenic and benzo(a)pyrene. Uncertainty in soils characterization is considered high, although the effect (over- or underestimate of site risks) is unknown.

Ground Water - Monitoring wells at the Himco CDA were sampled for different chemical parameters at different times, limiting the adequacy of the available chemical data base. However,

two shallow wells were assumed representative of potential ground water exposures. Monitoring well WT116A was chosen as it is located within the CDA, and monitoring well WT119A was chosen as it is located immediately down gradient of both the CDA and WT116A. Uncertainty in ground water characterization is considered high, although the effect (over- or underestimate of site risks) is unknown.

9.9.2 Selection of COPC's

Analytical Methods - All samples taken for the Himco CDA risk assessment were analyzed using the CLP. In some groundwater analyses, the CRQL or the SQL were equal to or greater than the risk-based screening level. When this occurred, the contaminant was retained as a COPC and evaluated quantitatively in the risk assessment if there were positive detects in any medium at the site. However, if the contaminant was not detected in any medium at the site, the contaminant was retained as a COPC, but was not included in the quantitative risk assessment. Although it is possible that this procedure underestimated site risks, it is likely that actual site risks were overestimated.

Data Qualifiers - All data for this assessment underwent validation according to the National Functional Guidelines, and appropriate data qualifiers were applied. Only data with an "R" qualifier (rejected) were eliminated from the data set. "J" and "B" qualified data were used as actual concentrations. This procedure may under- or overestimate risks, but the effect on the overall evaluation of site risks is considered minimal.

Evaluation of Site-Relatedness - The maximum downgradient ground water concentration was compared to the average upgradient concentration to determine if the contaminant should be considered site-related. This process was applied to inorganics only (i.e., all organics were considered to be site-related). Because the previously collected background data set (inorganics) for soils was determined to be unsuitable for evaluation of the current on-site data, all detections were assumed to be site-related. This process has the possibility to overestimate site-related risks due to the inability to distinguish site-related chemicals from background concentrations.

Essential Nutrients - If essential nutrients were present in ground water, screening was performed by comparing maximum detected concentrations of the analytes to the screening level derived using recommended dietary allowances (RDA's) or adequate daily dietary intake levels established for mineral and trace nutrients for children and adults (NRC, 1989). Any essential nutrients exceeding these criteria were retained as COPC's. This procedure may overestimate actual site risks. Sodium did not exceed its RDA, however, the maximum detected concentration of sodium in ground water (214 mg/L) exceeded the USEPA guidance level for drinking water of 20 mg/L (considered protective of those persons on a sodium-restricted diet). Sodium was not retained as a COPC. By not carrying sodium through the quantitative risk assessment, actual risks from sodium ingestion may have been underestimated.

Toxicity Screen - Maximum detected concentrations were compared to USEPA Region 9 PRG's. This evaluation reduces the possibility that site-related contaminants would be eliminated from the quantitative risk evaluation due only to toxicity considerations. Comparing maximum concentrations with risk-based screening levels to establish COPC's is conservative, but would have no significant effect on calculated site risks.

Duplicate Analyses - Some samples were split for duplicate analysis. For positive detections, the higher of the two values was used to represent the data point. This procedure may over- or under-estimate site risks, but is considered insignificant to the risk calculations.

9.9.3 Receptors

Both current and reasonably anticipated future site use was evaluated to establish receptors for the Himco CDA RA. Current site use is residential, and the site is expected to remain residential. Therefore, the RA evaluated potential risks to residents (adult and child for non-carcinogens, and integrated child/adult for carcinogens) as well as construction workers. Future site use may not remain residential as assumed, and the evaluation of future residential exposures may overestimate actual future risks presented by the site. Also, the calculated risks to construction workers may be underestimated if a major construction project is undertaken at the site instead of a simple home improvement project (as was assumed for the risk assessment).

9.9.4 Exposure Point Concentrations

Soils - As the exposure areas had too few samples to confidently calculate a 95% UCL, the maximum detected concentration was used as the EPC. Detected contaminant concentrations were variable, and may or may not be representative of soils available for exposure. Therefore, it is possible that actual site concentrations are higher than the EPC (underestimating risks), but it is reasonable to assume that use of the maximum detected concentration has overestimated actual site risks.

Ground Water - Monitoring wells at the Himco CDA were sampled for different chemical parameters at different times, limiting the adequacy of the available chemical data base. Maximum detections of contaminants in two shallow wells (WT119A and WT116A) were used to represent the EPC for ground water exposures. It was assumed that these wells were located in the most concentrated area of the known ground water plume, and would adequately represent the RME for site receptors. This procedure has most likely overestimated site risks. Additionally, residential exposure to VOC's was evaluated using the Andelman models to estimate airborne concentrations during showering and other household uses of ground water. As with any model, assumptions must be made to establish input parameters. Use of models and the associated input parameters may over- or underestimate actual conditions, however, application of conservative values to the model would bias the EPC higher, and tend to overestimate site risks.

9.9.5 Exposure Parameters

No site-specific exposure data were collected for this assessment. Exposures were evaluated using USEPA's Standard Default Exposure Factors (USEPA, 1991a), age-adjusted default values (USEPA, 1996), and dermal exposure factors (USEPA, 1992) to calculate the RME for all receptors. Use of these upper-end values is intended to evaluate the maximum long-term exposure that is reasonably expected to occur at the site, and most likely overestimates average or central tendency site exposures. The risk assessment did not consider pica behavior or other high-contact activities which might result in acute risks.

9.9.6 Exposure Routes

A CSM was developed to assist in determining appropriate exposure routes for the receptors chosen for this RA. Some routes of possible exposure may have been overlooked, and some may have been included inappropriately. Either of these could result in actual site risks being over- or underestimated.

9.9.7 Toxicity Values

For a risk to exist, there must be significant exposure to COPC's, and the COPC's must be toxic at the predicted exposure levels. In general, the methodology used to develop CSF's and RfD's is conservative and likely results in an overestimation of human toxicity.

Cancer Slope Factors - CSF's are developed assuming there is no safe level of exposure to any chemical suspected or proven to cause cancer. They represent a plausible upper-bound estimate of the carcinogenic potency of the chemical as a result of a lifetime exposure to the indicated level of the chemical. The actual individual risk posed by each carcinogen is unknown, but it is likely to be lower than the calculated risk and may even be as low as zero (USEPA, 1989). The result is that use of these values typically overestimates actual carcinogenic risk.

Oral Reference Dose - The RfD_o is typically derived by applying several uncertainty factors to a NOAEL or LOAEL determined from a dose-response study in animals. Additional modifying factors may also be applied to account for qualitative professional assessment of uncertainties in the available toxicity data. Therefore, the RfD_o is likely to be protective, and its use probably results in a moderate overestimation (as much as an order of magnitude) of the potential for noncarcinogenic hazard.

Inhalation Reference Dose - The RfD_i is analogous to the oral RfD and is likewise based on the assumption that thresholds exist for certain toxic effects. In general, the RfD_i is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. For this risk assessment, RfD_i's were calculated from reference

concentrations (RfC's). This procedure of calculating a safe intake from a safe concentration utilizes adult parameters, which may underestimate intakes by children. Therefore, the RfD_i may underestimate potential noncarcinogenic hazards to children and may over- or underestimate those hazards for adults.

Lead - Although IRIS lists lead as a class B2 carcinogen, no CSF or RfD is listed. Therefore, application of standard risk assessment procedures could not be done. On-site detections of lead were compared to the OSWER residential screening level for lead in soils of 400 mg/kg and the action level of 15 µg/L in drinking water. Lead was detected in one surface soil sample above the screening level at an estimated concentration of 695 mg/kg. All other samples were below 400 mg/kg. While specific risk estimates were not calculated, lead was retained as a COPC in CDA soil. It should also be noted that samples for lead analysis were totals, not sieved for analysis of the fine fraction (the fraction more likely to adhere to hands and most likely to accumulate indoors). Stern (1994) has suggested that concentrations in sieved soil may reasonably be expected to be 1.4 times the level in unsieved soil; thus lead may be present at levels of approximately 1000 mg/kg in CDA soil in at least one Land Parcel. These procedures are expected to underestimate actual risks from lead exposure, especially for child residents.

9.9.8 Risk Characterization

As little information exists on the synergistic and antagonistic effects of COPC's, cancer risks and noncancer hazards for a given receptor were assumed to be additive through all applicable exposure routes. This procedure may over- or underestimate actual risks or hazards from exposure to the COPC's.

9.10 Summary and Conclusions

9.10.1 CDA Soils and Downgradient Ground Water

9.10.1.1 Construction Worker

For the construction worker, the estimated incremental lifetime cancer risks (ILCR's) due to site-related chemicals in soil at Land Parcels S, T, F, and D are greater than 1 in 1,000,000 (1E-06). The estimated risks to chemicals in soil at Land Parcels S, T, F, and D are 1.7E-06, 4.6E-06, 7.1E-06, and 1.3E-06, respectively. Overall, the only unacceptable noncancer hazard risk (HQ > 1) to present or future construction workers is in Land Parcel F (HQ 1.3) and is due to ingestion of and dermal contact with metals in soil.

This assessment has only considered short term exposure such as would occur with a residential home improvement project. It does not consider potential health impacts to construction workers which could be imposed by major construction projects, such as new home construction or a large scale development which could occur under either the current or future land use. Any such

activities would require a re-evaluation of the worker risks.

9.10.1.2 Age-Adjusted and Child Resident

Estimated ILCR's due to site-related chemicals in soil for the age-adjusted resident at all Land Parcels are greater than 1 in one million (1E-06), and exceed 1 in 10,000 (1E-04) in two parcels, F and S. A third Land Parcel, Q, had risk estimates due to soil contaminants at 9 in 100,000 (9E-05). The soil risks are attributable to arsenic, benzo(a)pyrene and dibenz(a,h)anthracene. In addition, arsenic, benzene, and vinyl chloride contributed to a ground water risk of greater than 1 in 10,000 (1E-04). The overall total risk to the age-adjusted resident for all Land Parcels is greater than 1 in 10,000 (1E-04).

The noncancer total risks in all Land Parcels for the child resident (the more conservative noncarcinogenic assessment) are greater than 1. This is primarily due to risk to ground water. The estimated site-related HI for the child resident for well-pair WT116A/WT119A is 46. The unacceptable noncancer hazard risk for ground water is due to antimony, iron, manganese, thallium, benzene and 1,2-dichloropropane. Two Land Parcels had estimated site-related HI's greater than 1 for the child resident exposed to soil. The estimated site-related HI for Land Parcel S is 2.9 (arsenic, antimony, copper, manganese) and Land Parcel F is 4.5 (predominantly mercury).

For surface soils, the USEPA Office of Solid Waste and Emergency Response directive includes 400 mg/kg lead screening level for residential soil as an appropriate screening level for inorganic lead (USEPA, 1998a, 1994c). At the Himco CDA, lead was detected above the residential screening level in Land Parcel F in one surface soil sample at an estimated concentration of 695 mg/kg. Lead was also detected in other surface, near surface and subsurface soil samples at Land Parcels F, D, S and O (no soil samples were collected at Land Parcel N, R, Q and T). Although the concentrations detected were below the screening level, the concentrations represent lead concentrations in unsieved samples. It has been determined that lead concentrations in soil generally increase with decreasing particle size Therefore, use of the total soil concentrations likely underestimates the overall risk to lead in the identified parcels.

At Land Parcel N, R, Q and T no soil samples were collected and soil concentrations in surrounding land parcels were projected into Land Parcel N, R, Q and T in order to evaluate the risk. However, all parcel assessments suffer from a paucity of sample data with which to conduct an accurate characterization of the CDA soils. The presence of several metals at varying concentration, as well as other contaminants through-out the CDA area, strengthens the concern for adverse health impacts from frequent or prolonged contact with the soils in this area.

A summary of carcinogenic and noncarcinogenic risk estimates for residential receptors from exposure to ground water and soil in each Land Parcel is presented below.

Risk Summary for Himco CDA Residential Scenarios

Himco Land Parcel	Carcinogenic Risk			Noncancer Hazard Index		
	GW	Soil	Total	GW	Soil	Total
M	**3.0E-04**	3.0E-05	**3.3E-04**	**46**	0.50	**46**
O	**3.0E-04**	3.2E-05	**3.3E-04**	**46**	0.76	**47**
N	**3.0E-04**	1.9E-05	**3.2E-04**	**46**	0.11	**46**
P	**3.0E-04**	2.9E-05	**3.3E-04**	**46**	0.71	**47**
S	**3.0E-04**	**1.1E-04**	**4.1E-04**	**46**	**2.9**	**49**
T	**3.0E-04**	4.2E-05	**3.4E-04**	**46**	0.31	**46**
Q	**3.0E-04**	**8.6E-05**	**3.9E-04**	**46**	0.59	**47**
R	**3.0E-04**	4.6E-05	**3.5E-04**	**46**	0.27	**46**
F	**3.0E-04**	**1.5E-04**	**4.5E-04**	**46**	**4.5**	**50**
D	**3.0E-04**	6.4E-05	**3.6E-04**	**46**	**0.97**	**47**

10.0 EASTERN OFF-SITE RESIDENTIAL HUMAN HEALTH RISK ASSESSMENT

10.1 Purpose and Scope of this Risk Assessment

The purpose of the Eastern Off-Site Residential Assessment (EA) was to conduct a human health risk evaluation that more reasonably addresses the exposures to ground water by those residents living to the east of the Himco Dump Site. The ground water analytical data set for the EA includes the ground water data set used by Donohue to conduct their risk assessment [1990/1991 RI data set (Donohue, 1992)], the 1995 Pre-Design sampling event conducted by USACE [as documented in the *Final Pre-Design Technical Memorandum, Himco Dump Site, Elkhart, Indiana* (USACE, 1996)], the 1996 USEPA Supplemental Site Investigation analytical data involving the ground water downgradient of the landfill, the 1998 Supplemental Site Investigation analytical data involving CDA soils and ground water downgradient of the landfill, and the 2000 Supplemental Site Investigation analytical data (April/May and November 2000) involving ground water downgradient of the landfill. Ground water analytical data was collected from both monitoring wells and direct-push point locations as part of the April/May 2000 investigation. In addition, the residential well data collected from the March, April/May and November 2000 sampling events will be used qualitatively in the risk assessment. The investigative data and risk evaluation will provide USEPA Region 5 with additional information for determining whether further remedial elements are necessary and warranted for area ground water east of the Himco Dump Site.

10.2 Conceptual Site Model

Principle elements of the CSM for downgradient ground water are reviewed in Chapter 8.

10.2.1 Sources, Release Mechanisms, and Affected Media

The sources, release mechanisms, and affected media are described in Section 8.1

10.2.2 Current and Future Land Use Scenario

For purposes of the Eastern Off-Site Residential Assessment, and based on current and expected future land uses near the site, receptors are defined as residents living east and southeast (referred hereafter as east) of the Himco Dump Site that potentially could be exposed to site-related contaminants in ground water.

10.2.3 Characterization of Exposure Pathways

For a site contaminant to pose a potential risk to receptors, there must be a completed exposure pathway from the affected media to the receptor. Potentially completed exposure pathways for residential receptors are summarized below.

10.2.3.1 Ground Water Exposure Pathways

The release mechanisms for ground water include direct releases at or below the water table and leaching of contaminants from soil in infiltrating precipitation. Completed exposure pathways from ground water were assumed to be possible for receptors (e.g., residents) that use extracted ground water for household use, as drinking water (private wells are the sole source of drinking water and water for other household use in this residential area), and during showering or bathing.

10.2.3.2 Air Exposure Pathways

Receptors evaluated at the Himco Dump Site could be exposed (via the inhalation route) to contaminants volatilizing from ground water that could migrate through the soil medium and discharge into ambient air and indoor spaces.

The discharge of volatiles from soil vapor into ambient air or indoor air was not assessed in this EA. Although soil gas data were collected in this investigation (and discussed in Chapter 5), the objectives were to determine if soil gas was indeed migrating from the landfill boundary, and to aid in evaluating remedies proposed for the site. Because of the sampling locations for these data, the data are not suitable for modeling volatile gas concentrations in ambient (outdoor) air or in indoor air, and therefore were not used quantitatively; however, Figures 5-5 through 5-7 present the contoured concentration data for the compound classes BTEX (benzene, toluene, ethyl benzene and xylene), chlorinated ethenes, and chlorinated ethanes. The highest concentrations of BTEX were found along the southeast side of the landfill (Figure 5-5). The highest concentrations of chlorinated ethenes and chlorinated ethanes were also found along the southeast side of the landfill (Figures 5-6 and 5-7).

All detected compounds appear to be distributed similarly, with higher concentrations measured just off the boundary of the landfill, and a trend of decreasing concentrations moving away from the landfill perimeter, with the highest detected concentrations found in the southeast corner of the site just northwest of the intersection of County Road 10 and John Weaver Parkway.

10.3 Evaluation of the Site Characterization Data for the Eastern Residential Area

10.3.1 Data Evaluation

This section briefly reviews the decisions made regarding the use of the data for quantitative risk assessment purposes. Analytical data collected from ground water from the Himco Dump Site during the events described in Section 10.1 were included in the data set. From this data set, ground water results from monitoring wells WT101A, WT114 A and WT114B, were evaluated with respect to the criteria presented in Chapter 4. The analytical data from these monitoring wells considered to be acceptable for use in this assessment are presented in Table 2-1. The analytical data from select direct-push wells (GP16, GP101 and GP114) were also included in the data set. These monitoring wells, and direct-push sampling points located along the eastern perimeter of the landfill, were chosen

as they are located immediately downgradient of the landfill. Given the available data set, they represent the most contaminated area, both horizontally and vertically, of the ground water plume migrating from the landfill to the east and southeast. As indicated in Chapter 7, the vertical migration of contaminants in ground water from the Himco Dump Site is not well defined. Very limited vertical profiling, completed during the 2000 Supplemental Site Investigation using direct-push methods, indicates the potential for preferential zones of migration. These zones are not well defined and the vertical distribution of contaminants is uncertain. Some of the residential wells east of the landfill have concentrations of contaminants at, or higher than, concentrations found in monitoring wells. Thirteen residential water wells located to the east of the landfill were sampled during the 2000 Supplemental Site Investigation. Water well construction details were found for only 5 of these wells. Screened intervals for these residential wells ranged from 45-50 feet, 60-65 feet, and 74-78 feet below ground surface. Monitoring wells WT101A and WT114A are screened across the water table, and WT114B is screened from 60.3-65.3 feet below ground surface. None of these monitoring wells are necessarily screened at the correct depth to optimally capture the greatest vertical concentrations of contaminants. Therefore, ground water analytical data from direct-push sampling points were also included.

The data sets (site data and background) were developed further using the following criteria:

- Rejected ("R"-qualified) data were excluded from the data sets.
- Chemicals which were analyzed for but not detected, were reported with a "U". These sample results, including those qualified with a "UJ", were used in the risk assessment as non-detects where applicable (background ground water).
- Any detected value for an analyte, which was also detected in an associated blank, is qualified with a "B" unless the amount present is less than ten times the blank concentration for the common laboratory contaminants or five times the amount present in the blank for all other analytes. Data that is qualified "B" are used in the same way as positive data that do not have this qualifier. Any detected value for an analyte that is less than ten times the amount measured in an associated blank for the common laboratory contaminants or five times the amount measured for all other analytes is qualified "UB". Analytes qualified "UB" were not used in the risk assessment.
- If a single, unqualified analyte value was provided for a given sample/location/date, this value was included in the data sets.
- Values reported as estimated ("J" qualified) were included in the data sets, as if they were unqualified.
- If a chemical was detected at least once in ground water, surrogate values for any non-detects for that analyte in the matrix were included in the risk data sets at one-half the contract-

required quantitation limit (CRQL) or the sample quantitation limit (SQL), where applicable (background ground water).

- For duplicate ground water sample pairs, the most conservative (i.e., greater) value was used. If both values were non-detects, the value representing the highest CRQL or SQL was used, following the SQL surrogate method described above, as applicable (background ground water). Rejected ("R"-qualified) data were excluded from the data sets.

10.3.2 Methodology for Selection of Chemicals of Potential Concern

All chemicals detected in the above described monitoring wells and direct-push point locations were determined acceptable for use, except as noted in Chapter 4 and/or on Table 2-1, and were evaluated to identify preliminary chemicals of potential concern (COPC's) for the residential receptor. Several screening steps were performed to focus the EA on chemicals with a potential to pose a risk to human health. The screening steps included:

- Elimination of essential nutrients;
- Comparison of site concentrations to upgradient concentrations for metals (i.e. site-attribution analysis); and
- Toxicity screening.

10.3.2.1 Essential Nutrient Screening

A chemical may be excluded as a COPC if it is an essential trace element or dietary requirement, and conservative exposure to the element in site media would result in intakes at or less than health-protective levels. If essential nutrients were present in ground water, screening was performed by comparing maximum detected concentrations of these analytes to the screening level derived using recommended daily allowances (RDA's) established for children ages 1-10 (calcium and iron) and children ages 1-13 (magnesium) (NRC, 1989). Daily dietary intake levels established for adults for potassium and sodium were used as screening levels (NRC, 1989). For potassium, the minimum dietary requirement in adults ranges from 1,600 to 2,000 mg per day. In addition, the lower range value of 1,600 is the average intake for an infant at the end of the first year of life. Therefore the range of 1,600 to 2,000 mg per day for potassium was used as a representative acceptable intake. For sodium, there is only a recommended intake based on the adult.

To make this comparison, the screening level was derived by dividing the RDA (if more than one age group RDA was given; e.g., for children, RDA's for age groups 1-3 years, 4-6 years, etc., the values were averaged) by 2 L water/day (the USEPA default residential drinking water ingestion rate for adults). If the maximum detected concentration was $\geq$ to the RDA-based screening level, the nutrient was listed as a COPC or analyzed further by other screening criteria in the risk assessment. If the

maximum detected concentration was < the RDA, no further analysis was required.

Only one essential nutrient, iron, was retained as a site-related COPC in ground water. Iron was present in ground water at the Himco Dump Site at concentrations greater than the respective intakes at health-protective levels. Iron RDA screening exceedences in ground water were consistently seen in well-pair WT101A/WT114A in both 1995 and in the current (2000) investigation. With excess dietary intake, iron overload may result in disturbances of liver function, diabetes mellitus, endocrine disturbances, and cardiovascular effects (NRC, 1989).

Although sodium was not retained as a site-related COPC, it should be noted that the USEPA Office of Water has issued a Drinking Water Advisory to provide guidance to communities that may be exposed to drinking water containing sodium chloride or other sodium salts. This advisory recommends reducing sodium concentrations in drinking water to between 30 and 60 mg/L. This range is based on esthetic effects (i.e., taste), and would only contribute 2.5 - 5 percent of the daily dietary goal of 2,400 mg/day, if tap water consumption is 2 liters/day (USEPA, 2002a). At the present time, the USEPA guidance level for sodium in drinking water is 20 mg/L, developed for those individuals restricted to a total sodium diet of 500 mg/day (USEPA, 2002a). The maximum detected sodium concentration found in residential wells to the east is 125 mg/L, which is above the advisory level, but below the daily dietary level of 250 mg/L. However, the daily contribution of sodium in the diet through drinking site ground water would be 50 percent.

10.3.2.2 Comparison with Background/Site-Attribution

Validated analytical results for non-nutritive metals detected in upgradient and downgradient ground water were compared to identify constituents present at concentrations greater than upgradient levels (i.e. site-related). All organic chemicals detected were considered to be site-related, and were not subject to site-attribution analysis.

Upgradient ground water data were collected from the 1995, 1998, and April/May 2000 ground water sampling events. Data from the events for upgradient wells WT102A and WT112A were combined and averaged (arithmetic mean) to determine upgradient ground water quality. The maximum detected concentration of a chemical constituent from the downgradient ground water data set for this assessment was then compared to the average upgradient ground water concentration as part of the COPC selection process. If the maximum detected concentration was greater than the average upgradient concentration for an analyte, then the analyte was retained as a COPC.

A summary of site-related non-nutritive metals in downgradient ground water is as follows:

-Aluminum	-Manganese	-Iron	-Vanadium
-Selenium	-Chromium	-Cyanide	-Lead
-Cadmium	-Mercury	-Barium	
-Arsenic	-Thallium	-Cobalt	

10.3.2.3 Toxicity Screening/Risk-Based Screening Comparisons

Maximum detected concentrations and risk-based screening values for preliminary COPC's in downgradient ground water at the site were compared to focus the risk assessment on those chemicals with a potential to pose an unacceptable risk to the receptors evaluated. Chemicals that exceeded their respective risk-based screening values were retained for further analysis. The risk-based screening values were based on chronic receptor-specific exposures.

The analytical data were compared to Preliminary Remediation Goals (PRG's) developed by USEPA Region 9 (USEPA, 2000a) for ground water exposure via ingestion and inhalation. The screening process is based upon a PRG excess cancer risk level of 10^{-6} and an adjusted hazard quotient (HQ) of 0.1 for noncarcinogens. These adjustments are made to provide additional protection for simultaneous exposure to multiple chemicals. For carcinogens, the method for calculating PRG's uses an integrated 30-year adult exposure that takes into account the difference in daily ingestion rates, body weights, and exposure duration for 6 years as a child and 24 years as an adult. This health-protective approach is chosen to take into account the higher daily rates of ingestion in children as well the longer duration of exposure that is anticipated for a long-term resident. For noncarcinogenic concerns, the more protective method of calculating a PRG is to evaluate childhood exposures separately from adult exposures (i.e., an age-adjustment factor is not applied as was done for carcinogens). This approach is considered conservative because it combines the higher 6-year exposure for children with chronic toxicity criteria.

10.3.3 Selection of Chemicals of Potential Concern for the Eastern Residential Area

All chemicals detected in ground water in wells WT114A, WT114B, WT101A and direct-push point locations GP16, GP101, and GP114 were evaluated to identify COPC's. The chemicals remaining upon completion of the data evaluation steps (Section 10.3.2.1) and essential-nutrient and site-attribution analysis steps (Section 10.3.2.2) were retained for further evaluation for the eastern residential area. A comparison was then made between the maximum detected concentrations and PRG for ground water (Section 10.3.2.3).

The comparison of maximum detected chemical concentrations in ground water to the screening criteria for the Himco Dump Site is presented in Table 10-1. The chemicals that exceeded their respective screening criteria and are retained as COPC's for the quantitative risk evaluation are the following:

-Arsenic
-Chromium
-Iron
-Manganese
-Thallium
-1,2-Dichloropropane
-Benzene
-Bis(2-ethylhexyl)phthalate

10.4 Exposure Assessment

10.4.1 Characterization of the Exposure Setting

The exposure assessment consists of three main steps:

- Evaluation of exposure pathways and identification of receptors;
- Estimation of exposure-point concentrations; and
- Estimation of human intake.

Each of these steps is described in detail in the following subsections.

10.4.1.1 Exposure Area

For purposes of this assessment, and based on current and expected future land uses at or near the site, the exposure area is the residential area located directly east and southeast of the Himco Dump Site. The exposure area evaluated in the eastern assessment is associated with the following sources of ground water contamination at the Himco Dump Site:

Ground water well or well-pair locations. Monitoring wells and direct-push point locations were selected in order to quantitatively determine exposure to receptors drawing water from ground water east and southeast of the Himco Dump Site. Monitoring wells WT101A, WT114A and WT114B, and direct-push point locations GP16, 101, and 114 were chosen as described in Section 10.3.1.

10.4.1.2 Exposure Population/Receptor Identification

A site-specific conceptual site model (CSM) (Figure 8-1) was used to qualitatively define the type of potential exposures to contaminants at or migrating from the site (i.e., to systematically evaluate the impact of chemicals in relevant media to potential receptors). Such models are mechanisms for identifying potentially completed exposure pathways between physical media affected by site-related contamination and potential receptors. A general description of CSM's is provided in Chapter 8, and the potentially complete exposure pathways and receptors for the EA are identified in this section.

Consistent with RAGS (USEPA, 1989), current and future land-use scenarios were considered for the EA. Potential receptors include current and future off-site residents (adult and child). Residents were assumed to be exposed to ground water via ingestion (drinking water), dermal contact, and inhalation of volatiles while performing household activities, and showering or bathing.

10.4.2 Estimation of Exposure-Point Concentrations for the Eastern Off-Site Residents

Exposure-point concentrations (EPC's) are intended to be representative of the concentrations of chemicals in a given medium to which a receptor may be exposed (i.e., the exposure point). For the eastern assessment, EPC's were estimated using analytical data obtained from site sampling or using modeling (e.g., indoor air concentrations derived from chemical concentrations in ground water). Exposure point concentrations for receptor exposures to VOC's in air were estimated as described in the Andelman model (Andelman, 1990). Current concentrations in ground water were assumed to be representative of future concentrations. Table 9-4 summarizes the potentially exposed receptors, and how the EPC's were developed for this risk assessment.

10.4.2.1 Exposure-Point Concentrations for Ground Water

The ground water data set used to develop the exposure-point concentrations is described in Section 10.3.1.

Because multiple sampling results were available for the individual wells and direct-push points, the maximum concentration detected in any well or direct-push point was used to obtain the best approximation of the EPC for chemicals in ground water (Table 9-6). It was assumed that this concentration could be present in any of the wells and direct-push points at any time.

10.4.2.2 Exposure-Point Concentrations for Air Volatiles from Ground Water

Exposure-point concentrations of VOC's in air due to volatilization from ground water during showering and household use exposures, (applicable to the residential receptor), were estimated using the Andelman models (Andelman, 1990). Although a child residential receptor may typically take baths rather than shower, the shower model (using a bath duration time) was still assumed to be an adequate and conservative estimate for deriving VOC EPCs in air from ground water for a child resident bathing in an enclosed space. This assumption is based on the following: 1) water volumes from a shower versus a bath are comparable (150 L); as well as 2) comparable water use transfer efficiencies (percent volatilization) as determined for radon by Prichard and Gesell (1981) as referenced by Andelman (Andelman, 1990) (shower - 63% vs. bath - 47%).

The Andelman models for shower and whole-house exposures are simple models. They employ the use of a one-compartment area and assume the rate of volatilization is constant. They further assume that all volatile constituents (i.e., constituents with a Henry's law constant of 2E-06 atm-m^3/mol or greater) are equally volatilized and that below a threshold Henry's law constant of 2E-06 atm-m^3/mol, no volatilization occurs. In the case of very volatile compounds, this approach may be adequate, but it will tend to overestimate exposure if semivolatile constituents are included in risk assessment.

Exposure point concentrations of VOC's in air due to volatilization from ground water during showering were calculated using the equation presented in Section 9.5.3.5 (numerical values for

equation variables are presented in Table 9-8):

Exposure-point concentrations of VOC's in air due to volatilization from ground water during household use activities, applicable to the resident, were estimated using the equation presented in Section 9.5.3.5 (numerical values for equation variables are presented in Table 9-8):

The discharge of volatiles from soil vapor into ambient (outdoor) air or indoor air was not assessed in this RA. Although soil gas data were collected in this investigation (and discussed in Chapter 5), the objectives were to determine if soil gas was indeed migrating from the landfill boundary, and to aid in evaluating remedies proposed for the site. Because of the sampling locations for these data, the data are not suitable for modeling volatile gas concentrations in ambient air or in homes, and therefore were not used quantitatively; however, Figures 5-5 through 5-7 present the contoured concentration data for the compound classes BTEX, chlorinated ethenes and chlorinated ethanes. All of the listed compound classes were found along the entire length of the eastern perimeter of the landfill where sampling was performed.

10.5 Estimation of Media Intakes

Intake, expressed as milligrams of chemical per kilogram of body weight per day (mg/kg-day), is obtained by multiplying the EPC by several exposure factors which are specific to an exposure scenario.

USEPA (USEPA, 1992) defines two types of exposure estimates currently used for Superfund risk assessments: a reasonable maximum exposure (RME) and a central tendency (CT) exposure. The RME is defined as the highest exposure that reasonably could be expected to occur for a given exposure pathway at a site, and is intended to account for both uncertainty in the contaminant concentration and variability in the exposure parameters. Because this is a supplemental evaluation rather than a baseline risk assessment, only the RME scenario was estimated. This approach is conservative because the RME is based on the upper bound estimates of the input parameters.

In accordance with USEPA guidance (USEPA, 1989), intakes for carcinogens were calculated differently from those for noncarcinogens. For carcinogens, intake was averaged over an assumed lifetime of 70 years. This is appropriate because cancer is considered to be a non-threshold phenomenon and because multiple individual chemical exposures which could result in the development of cancer are accrued over a lifetime. The probability of developing cancer is believed to be proportional to the duration and intensity of exposure. That is to say, the probability of developing cancer is proportional to the dose of chemical absorbed into the body, the frequency of exposure, and the length of exposure.

Because contact rates, body weights, exposure durations, and in some instances, exposure times are different for children and adults, carcinogenic risks for residential receptors during the first 30 years of life were calculated by age adjusting for each exposure route. The age adjustment estimates the

total exposure to an individual by combining contact rates, body weights, and exposure durations for children 1 to 6 years old and others from 7 to 31 years old. The equations used for age adjusting for the ingestion, dermal contact, and inhalation pathways are discussed in further detail later in this section.

For noncarcinogens, the intake was averaged over the duration of exposure. This reflects the assumption that noncarcinogenic effects have a toxicity threshold. Adverse health effects would result if the toxicity threshold were exceeded for a period of time during an average lifetime. That is, lifetime exposure of a receptor to a chemical at a concentration below the threshold is not expected to result in adverse effects.

In this assessment, a childhood-only exposure scenario was used to evaluate off-site residential noncancer hazards. This approach is considered conservative because it combines the higher 6-year exposure (and hence higher intake) for children with chronic toxicity criteria. The issue of using a chronic reference dose (RfD) to evaluate childhood exposures was explored by USEPA (USEPA, 1996b) for developing Soil Screening Levels (SSL's), which does use the childhood-only approach. USEPA (USEPA, 1996b) noted that this approach was appropriate for chemicals such as nitrate/nitrite and fluoride, for which the verified chronic oral RfD's are based on empirical data from childhood exposures, and for chemicals with steep dose-response curves. For most other chemicals USEPA determined that this approach may be overly protective.

The primary exposure parameters used to estimate risk/hazard per the equations presented below, the justification for the parameter values used, and the references for the values selected are summarized in Table 9-8.

10.5.1 Equations for Estimating Intake

10.5.1.1 Ingestion of Ground Water

The ingestion intake of COPC's in ground water for the child resident (noncancer) was estimated using the equation in Section 9.6.1.4. The ingestion intake (cancer evaluation) was calculated using an age-adjusted ingestion rate factor to reflect an average daily lifetime exposure for the resident. The age-adjusted water ingestion rate factor is described in Section 9.6.1.4. The ingestion intake of COPC's in ground water for the off-site age-adjusted resident (cancer evaluation only) was estimated as described in Section 9.6.1.4.

10.5.1.2 Dermal Contact with Ground Water

Quantification of dermal uptake of constituents from water depends on a permeability coefficient (Kp), which describes the rate of movement of a constituent from water across the dermal barrier to the systemic circulation (USEPA, 1992). Ground water dermal uptake applies to the adult and child resident (i.e. showering/bathing). The equation for dermal uptake of chemicals from water is the same

as the equation for dermal uptake of chemicals from soil. An additional equation, however, must be derived to account for the off-site age-adjusted resident for dermal exposure to inorganics in ground water (cancer evaluation). For exposure to organics in ground water (cancer evaluation), the dermal uptake equation was used to calculate exposure to the adult and child receptors, separately, to account for the complexity of the exposure time in relation to the uptake of organic chemicals. The uptakes for the two receptors were added together to account for exposure to the adult and child during the first 30 years of life and averaged over a lifetime.

The age-adjusted water skin contact factor, SFW_{adj}, is derived by analogy to the age-adjusted soil skin contact factor. The calculation is described in Section 9.6.1.5. The age-adjusted off-site resident dermal exposure to inorganics in ground water (cancer evaluation) equation is described in Section 9.6.1.5. Separate calculation methods were applied to estimate DA_{event} for inorganic and organic chemicals in water. For inorganic chemicals, the average dermally absorbed dose of COPC was calculated as described in 9.6.1.5.

10.5.1.3 Inhalation of VOC's in Ground Water

The off-site resident may be exposed to airborne VOC's released from ground water during showering/bathing and household uses. The equation (USEPA, 1989) described in Section 9.6.1.6 was used to estimate the intake of airborne COPC's during these scenarios.

10.5.2 Receptor-Specific Intake Variables

Discussion of each of the variables used in the intake equations described in the previous section is presented in the following text. The variables are summarized in Table 9-8 .

10.5.2.1 Current/Future Eastern Off-Site Resident

The cancer assessments were based on an age-adjusted resident exposure using default values supplied by USEPA (USEPA, 1996b). The noncancer evaluations assumed a child exposure (a more conservative evaluation than adult), as described above. The RME evaluations assumed that a 70-kg adult was exposed for 24 years (USEPA, 1991a) and a 15-kg child was exposed for 6 years (USEPA, 1991a). The USEPA default RME exposure frequency of 350 days/year (USEPA, 1991a), was used for cancer and noncancer evaluations.

The age-adjusted drinking water ingestion factor (IFW_{adj}) of 1.09 L-years/kg-day was calculated using the USEPA default drinking water rates of 2 L/day for the adult and of 1 L/day for the child (USEPA, 1997b).

The age-adjusted water skin contact factor, SFW_{adj}, is derived by analogy to the age-adjusted inhalation and drinking water ingestion factors using the equation described in Section 9.6.1.5. The average total adult body surface area is approximately 20,000 cm^2 (USEPA, 1992). The average total

body surface area for children ages 2 to 6 years is estimated at 7,300 cm^2 (USEPA, 1992), which was adopted as the surface area of the skin available for contact with water in a bathing scenario. From the equation above and exposure durations defined earlier for the adult resident, an RME age-adjusted water skin contact factor of 3,561 cm^2-year/kg was estimated. The total exposure time in the shower room for the adult was 12 minutes (USEPA, 1997b). The total exposure time in the bath for the child was 45 minutes (USEPA, 1997b).

The RME inhalation factor for determining the risks for the age-adjusted resident due to inhalation of VOC's from ground water while showering/bathing was calculated using the algorithm provided by USEPA (USEPA, 1996b), the exposure durations defined above, an exposure time of 12 minutes for a showering adult and 45 minutes for a bathing child (USEPA, 1997b), and an inhalation rate of 0.6 m^3/hour for both the adult and child (USEPA, 1997b). The concentration in air, calculated using the Andelman model, for the age-adjusted resident assumed an adjusted time of approximately 30 minutes.

The RME inhalation factor for determining the risk for the age-adjusted resident due to inhalation of VOC's from ground water in indoor air from household uses was also calculated using the algorithm provided by USEPA (USEPA, 1996b), the exposure durations defined above, and an inhalation rate of 30 m^3/day for the adult, and 20 m^3/day for the child (USEPA, 1997b).

10.6 Toxicity Assessment

The most current available toxicity data (RfD or CSF) were used to calculate carcinogenic and noncarcinogenic risks/hazards, including the most recent Integrated Risk Information System (IRIS) (USEPA, 2000c) updates and Health Effects Assessment Summary Table (HEAST) values (USEPA, 1997a). Provisional toxicity values provided by USEPA were also used as appropriate. Toxicity values and additional physical and chemical values for all COPC's are listed in Table 9-9. In addition, toxicity profiles for the main chemicals are included in Appendix M.

Oral and inhalation toxicity values provided by USEPA reflect administered-dose values, that is they represent concentrations that will be protective following ingestion or inhalation. The dermal route of exposure, however, evaluates the toxicity of concentrations of chemicals in the blood (absorbed). Therefore, the absorbed-dose concentrations identified for dermal exposure must be compared to absorbed-dose toxicity values. The absorbed-dose toxicity values are derived by applying (multiplying) gastrointestinal absorption factors (GAF's) to administered-dose toxicity values. USEPA (Dan Stralka, Region 9, personal communication) recommends adjustment of the oral toxicity value when the (GAF) is less than 0.5. Default GAF's of 10 percent for organics and 1 percent for inorganics were used if literature values were unavailable.

10.7 Risk Characterization

To characterize potential noncarcinogenic effects, comparisons were made between projected intakes of substances and toxicity values. To characterize potential carcinogenic effects, the incremental

probability of an individual developing cancer over a lifetime was calculated from projected intakes and chemical-specific dose-response information. For each COPC having available toxicity values, a cancer risk (for carcinogenic risk) and/or hazard quotient (HQ) (for noncancer risk) estimate was calculated. The methods used to estimate risk/hazard and the carcinogenic and noncarcinogenic results (including risk summaries by pathway and receptor for current and future receptors) are presented herein.

10.7.1 Carcinogenic Effects

Carcinogenic risk is expressed as an increased probability of developing cancer as a result of lifetime exposure. For a given chemical and route of exposure, carcinogenic risk is calculated as follows:

$$\text{Risk} = \text{Intake} \times \text{CSF}$$

For simultaneous exposure to several carcinogens and/or exposure routes, cumulative risk is calculated using the following information.

$$\text{Risk}_T = \text{Risk}_1 + \text{Risk}_2 + ... + \text{Risk}i$$

where:

Risk_T = the total cancer risk, expressed as a unitless probability, and

Risk_i = the risk estimate for the *i*th substance.

USEPA considers that the simultaneous exposures to low doses of mixtures of chemical carcinogens may result in synergistic or antagonistic effects or some combination of both; however, due to the lack of data on the effects of mixtures, USEPA simply uses an additive approach, unless data are available on the effect of the mixtures of interest.

10.7.2 Noncarcinogenic Effects

The potential for noncarcinogenic effects was evaluated by comparing an exposure level or intake (chronic daily intake, or CDI) over a specified time period with a reference dose (RfD) derived for a similar exposure period. This ratio is termed the HQ. In other words, the HQ equals the intake divided by the reference value, or:

$$\text{Noncarcinogenic HQ} = \text{intake/RfD}$$

The HQ assumes that there is a level of exposure (i.e., RfD) below which it is unlikely for even sensitive populations to experience adverse health effects. If the exposure level exceeds the threshold (i.e., if HQ exceeds unity), there may be a concern for potential noncancer effects.

To assess the overall potential for noncarcinogenic effects posed by more than one chemical, a hazard index (HI) approach has been developed by USEPA (USEPA, 1989). This approach assumes that simultaneous sub-threshold exposures to several chemicals and/or route of exposure could result in an adverse health effect, while acting on the same target organ. The HI is calculated as follows:

$$HI = HQ_1 + HQ_2 + ... + HQ_i$$

where:

HQ_i = the hazard quotient for the *i*th toxicant.

It should be noted that exposure intake is taken to mean "chronic" exposure. Chronic exposure is defined as exposure that occurs over at least 7 years (USEPA, 1989).

10.8 Results of Risk Characterization for the Eastern Residential Area

The pathway-specific and cumulative cancer risks and noncancer hazards for the receptors quantitatively evaluated are summarized in Table 10-2. Calculations supporting these risk/hazard results are located in Appendix K.

10.8.1 Ground Water Chemical Risk Characterization-Carcinogens

The estimated potential carcinogenic risk to the adult resident east of the Himco Dump Site from exposure to groundwater is 5.8 in 10,000 (5.8E-04). The risk is predominantly due to: 1) ingestion of arsenic [5.4 in 10,000 (5.4E-04)], and 2) inhalation exposure to benzene [2.0 in 100,000 (2.0E-05)] during household use.

Table 10-2 provides a risk summary for ground water carcinogenic site risks to the adult resident east of the Himco Dump Site that includes chemical- and pathway-specific risk estimates. The total risk value is the sum associated with all carcinogenic COPC's across all pathways.

10.8.2 Ground Water Chemical Risk Characterization--Noncarcinogens

The estimated potential noncarcinogenic hazard to the child resident east of the Himco Dump Site from exposure to groundwater is a hazard index of 29. The child resident scenario was evaluated for the noncarcinogenic ground water hazards, because it is the most conservative scenario for the risk assessment. The site risk is predominately due to: 1) the child's inhalation exposure to benzene and 1,2-dichloropropane (HI = 4.4), and 2) the child's ingestion of arsenic, iron, manganese, and thallium (HI = 21). When the total HI from exposure to ground water is separated by target organ [i.e. arsenic-skin, iron-liver, manganese-CNS (Central Nervous System), thallium and benzene-blood, and 1,2-dichloropropane-respiratory], all of the target organ HI's exceed an HI of 1.0.

Table 10-2 provides a summary for ground water noncarcinogenic site risks to the child resident east of the Himco Dump Site that includes chemical- and pathway-specific risk estimates. The total hazard index (sum of the hazard quotients associated with all noncarcinogenic COPC's across all pathways) and the target-organ hazard indices are presented.

10.8.3 Ground Water East of the Himco Dump Site and Associated Residential Wells

In addition to the carcinogenic and noncarcinogenic risks described above that are based on analytical data gathered from ground water monitoring wells and/or direct-push points located east of the Himco Dump Site, analytical data was collected from private wells used by the residents east of the Himco Dump Site. The data collected from these wells is summarized in Chapter 3. All of the constituents detected in the private wells were also present in the ground water monitoring wells and direct-push points except for the following (i.e., these constituents were not detected in the ground water data set used in the risk assessment): vinyl chloride, 1,2-dichloroethane, chloroform and copper were detected at maximum concentrations (based on residential well sampling events in March, April and November) of 0.9, 1.0, 0.4 and 66.1 µg/L. All these maximum concentrations are above their respective Region 9 PRG screening values, except for copper, and all are below their respective Maximum Contaminant Levels (MCL's) of 2, 5, 100, and 1,300 µg/L.

An additional constituent 1,2-dichloropropane (evaluated in the risk assessment and also detected in one residential well) was evaluated in the risk assessment at a concentration less than the maximum detected concentration in the residential well (sampled over the three events). The carcinogenic risk for this constituent is 2.2 in 1,000,000 (2.2E-06) and the noncarcinogenic risk is 3.2. These risks are based on a concentration of 2.0 µg/L; the maximum concentration detected in the residential well is 10 µg/L. Therefore, the risks to the residents east of the Himco Dump Site may be underestimated. In addition, the residential well concentration exceeds the MCL for 1,2-dichloropropane of 5 µg/L.

Methylene chloride was also detected in one residential well at a maximum concentration of 6 µg/L. This concentration exceeds the MCL of 5 µg/L. The risk to methylene chloride was not evaluated; the maximum concentration detected in the ground water data set used in the risk assessment was 0.7 µg/L and was below the Region 9 PRG screening value of 4.3 µg/L. Therefore, the risks to the residents east of the Himco Dump Site may be underestimated due to the potential additional risk to methylene chloride not addressed in the risk assessment.

10.9 Uncertainty Analysis

Many factors contribute to uncertainty in the risk estimates provided in this assessment, including uncertainties associated with media concentrations and assumptions regarding receptor exposure, as well as individual variability. Uncertainty and variability can result in risk estimates being over-estimated or under-estimated, even when risk parameters are set to a conservative level to reduce the potential for under-estimation of site risks. Uncertainty in media concentrations can usually be reduced by increased data collection, as it is impacted by factors such as selection of sampling

locations, number of samples collected, analytical methods and errors, representativeness of the data, and such. Uncertainty introduced in the assumptions regarding receptor behavior can often be reduced by observing receptor activities, conducting surveys and interviewing receptors, especially when default values are used to characterize exposure activities. Variability, which includes individual variability in behavior that affects contact with contaminated media, differences in absorption and metabolism of contaminants, and differences in health status which affect health outcomes that may occur with exposure, can not usually be reduced. Identifying and discussing the major sources of uncertainty and their effect on the risk estimates allows for better interpretation of the results and decisions as to whether the uncertainties can be reduced (e.g., by collection of more data).

The primary sources of uncertainty specific to this assessment which are likely to have impact on the risk estimates are identified in Table 10-3 and are briefly summarized below.

10.9.1 Sampling Design

Ground Water - Three monitoring wells and three direct-push point locations at the Himco Eastern Off-Site Residential area were sampled to evaluate ground water concentrations for this RA. Maximum detections of contaminants were used to represent the EPC for ground water exposures. As some detections from the residential wells were higher than those used in this risk assessment (see discussion below), it is not known if the concentrations used are reflective of concentrations to which residents might be exposed. This procedure has likely underestimated site risks.

Residential Wells - Samples taken from residential wells had detections of vinyl chloride (0.9 µg/L), 1,2-dichloroethane (1.0 µg/L), chloroform (0.4 µg/L), and copper (66.1 µg/L) which were not detected in the monitoring wells or direct-push points, and were not used in the quantitative risk assessment. This procedure has most likely underestimated actual site risks. Two other constituents, 1,2-dichloropropane and methylene chloride, were detected in residential wells at concentrations above those found in the monitoring wells and direct-push points, and above their respective MCL's. This procedure has most likely underestimated actual site risks.

10.9.2 Selection of COPC's

Data Qualifiers - All data for this assessment underwent validation according to the National Functional Guidelines, and appropriate data qualifiers were applied. Only data with an "R" qualifier (rejected) were eliminated from the data set. "J" and "B"qualified data were used as actual concentrations. This procedure may under- or overestimate risks, but the effect on the overall evaluation of site risks is considered minimal.

Evaluation of Site-Relatedness - The maximum downgradient ground water concentration was compared to the average upgradient concentration to determine if the contaminant should be considered site-related. This process was applied to inorganics only (i.e., all organics were considered to be site-related). This process has the possibility to overestimate site-related risks due

to the inability to distinguish site-related chemcials from background concentrations.

Essential Nutrients - If essential nutrients were present in ground water, screening was performed by comparing maximum detected concentrations of the analyses to the screening level derived using recommended daily allowances (RDA's) or adequate dialy dietary intake levels established for mineral and trace nutrients for children and adults (NRC, 1989). Any essential nutrients exceeding these criteria were retained as COPC's. This procedure may overestimate actual site risks. Sodium did not exceed its RDA, however, the maximum detected concentration of sodium in ground water (125 mg/L) exceeded the USEPA guidance level for drinking water of 20 mg/L (considered protective of those persons on a sodium-restricted diet). Sodium was not retained as a COPC. By not carrying sodium through the quantitative risk assessment, actual risks from sodium ingestion may have been underestimated.

Toxicity Screen - Maximum detected concentrations were compared to USEPA Region 9 PRG's. This evaluation reduces the possibility that site-related contaminants would be eliminated from the quantitative risk evaluation due only to toxicity considerations. Comparing maximum concentrations with risk-based screening levels to establish COPC's would have no significant effect on calculated site risks.

Duplicate Analyses - Some samples were split for duplicate analysis. For positive detections, the higher of the two values was used to represent the data point. This procedure may over- or underestimate site risks, but is considered insignificant to the risk calculations.

10.9.3 Receptors

Both current and reasonably anticipated future site use was evaluated to establish receptors for the Himco Eastern Off-Site Residential area RA. Current site use is residential, and the site is expected to remain residential. Therefore, the RA evaluated potential risks to residents (adult and child for non-carcinogens, and integrated child/adult for carcinogens). Future site use may not remain residential as assumed, and the evaluation of future residential exposures may overestimate actual future risks presented by the site. Also, the calculated risks to construction workers may be underestimated if a major construction project is undertaken at the site instead of a simple home improvement project (as was assumed for the risk assessment).

10.9.4 Exposure Point Concentrations

As the exposure area included the entire ground water plume, the maximum detected concentration was used as the EPC as that concentration could be present at any location. As the residential wells had detections of contaminants that were not detected in the sampling points, and some contaminants were detected at higher levels in residential wells than in the sampling points used for the risks assessment, use of the maximum detected concentration may have underestimated actual risks to residential receptors. Additionally, residential exposure to VOC's was evaluated using the Andelman models

to estimate airborne concentrations during showering and other household uses of ground water. As with any model, assumptions must be made to establish input parameters. Use of models and the associated input parameters may over- or underestimate actual conditions, however, application of conservative values to the model would bias the EPC higher, and tend to overestimate site risks. Discharge of VOC's from soils into ambient (outdoor) or indoor air was not assessed as soil vapor samples were only taken at the perimeter of the landfill. This procedure results in an underestimation of exposure, and therefore an underestimation of site risks.

10.9.5 Exposure Parameters

Exposures were evaluated using USEPA's Standard Default Exposure Factors (USEPA, 1991a), age-adjusted default values (USEPA, 1996), and dermal exposure factors (USEPA, 1992) to calculate the RME for all receptors. Use of these upper-end values is intended to evaluate the maximum exposure that is reasonably expected to occur at the site, and most likely overestimates average or central tendency site exposures. This risk assessment did not consider pica behavior or other high-contact activities which might result in acute risks.

10.9.6 Exposure Routes

A CSM was developed to assist in determining appropriate exposure routes for the receptors chosen for this RA. Some routes of possible exposure may have been overlooked, and some may have been included inappropriately. Either of these could result in actual site risks being over- or underestimated.

10.9.7 Toxicity Values

For a risk to exist, there must be significant exposure to COPC's, and the COPC's must be toxic at the predicted exposure levels. In general, the methodology used to develop CSF's and RfD's likely results in an overestimation of human toxicity.

Cancer Slope Factors - CSF's are developed assuming there is no safe level of exposure to any chemical suspected or proven to cause cancer, and therefore represents the upper-bound limit of the carcinogenic potency of the chemical as a result of a lifetime exposure to the indicated level of the chemical. The actual individual risk posed by each carcinogen is unknown, but it is likely to be lower than the calculated risk and may even be as low as zero (USEPA, 1989). The result is that use of these values typically overestimates actual carcinogenic risk.

Oral Reference Dose - The RfD_o is typically derived by applying several uncertainty factors to a NOAEL or LOAEL determined from a dose-response study in animals. Additional modifying factors may also be applied to account for qualitative professional assessment of uncertainties in the available toxicity data. Therefore, the RfD_o is likely to be protective, and its use probably results in a moderate to high overestimation (as much as an order of magnitude) of the potential for noncarcinogenic hazard.

Inhalation Reference Dose - The RfD_i is analogous to the oral RfD and is likewise based on the assumption that thresholds exist for certain toxic effects. In general, the RfD_i is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. For this risk assessment, RfD_i's were calculated from reference concentrations (RfC's). This procedure of calculating a safe intake from a safe concentration utilizes adult parameters, which may underestimate intakes by children. Therefore, the RfD_i may underestimate potential noncarcinogenic hazards to children and may over- or underestimate those hazards for adults.

10.9.8 Risk Characterization

As little information exists on the synergistic and antagonistic effects of COPC's, cancer risks and noncancer hazards for a given receptor were assumed to be additive through all applicable exposure routes. This procedure may over- or underestimate actual risks or hazards from exposure to the COPC's.

10.10 Summary and Conclusions

10.10.1 Downgradient Ground Water

Estimated site-related carcinogenic risks for the age-adjusted resident scenario are attributable to ingestion of arsenic (5.8E-04) and inhalation of benzene (2.0E-05) during household use of ground water. The noncancer risk for the child resident (the more conservative noncarcinogenic assessment) is 29 and is due to arsenic, iron, manganese, thallium during ingestion of ground water (21), and benzene and 1,2-dichloropropane during household use of ground water (4.4).

As discussed in Section 10.8.3, these risks may be underestimated because certain constituents were not evaluated in the risk assessment, or were evaluated at concentrations less than that found in residential well(s). The detection of several contaminants in water from private wells at concentration above risk levels or drinking water MCL's strengthens the concern for adverse health impacts from use of water from private wells in the area to the east of the Himco Dump site.

11.0 CONCLUSIONS AND RECOMMENDATIONS

This Supplemental Site Investigations/Site Characterization Report was prepared to meet the joint objectives of summarizing the 1978 through 1995 Himco Dump Site ground water investigations and presenting the results of supplemental site investigations performed between 1996 and 2000. Ground water sample collection equipment and methodology, analytical results, and water level data for supplemental site investigations performed between 1996 and 2000 have been presented. Soil analytical data collected in 1998 and soil gas data collected in 1998 and 1999 are also presented in detail. Human health risk assessments, to supplement the assessment performed in 1992, were completed to quantify the risks from exposure to soils located within the area immediately adjacent to the southern perimeter of the Himco Dump Site known as the Construction Debris Area (CDA), and from exposure to ground water by residents to the south and east of the Himco Dump Site.

11.1 Conclusions of the Investigation

The following conclusions were reached based on these activities:

Ground Water:

- Analysis of ground water analytical data collected from 1978 to 2000 shows that the Himco Dump Site continues to contribute to the degradation of ground water quality.
- Ground water contamination emanating from the Himco Dump Site has migrated in both a horizontal and vertical direction. Complex vertical movement of ground water, and therefore contaminants, is likely. The vertical distribution of ground water contamination has not been completely defined.
- Vertical profiling using direct-push sampling methodology has determined that preferential zones of contamination may be present that are not intercepted by existing monitoring wells.
- Contoured ground water elevation data from multiple levels in the aquifer surrounding the Himco Dump Site show ground water flow predominantly to the south and southeast. These observations are consistent with other published regional and site specific interpretations of ground water elevation data.
- The ground water analytical data collected from 1996 through 2000 confirm previous sampling results that show that a consistent pattern of low part per billion levels of volatile organic compound and sporadic metal contamination persists . The analytes detected are primarily benzene, 1,2-dichloropropane, trichloroethene, 1,1-dichloroethane, cis 1,2-dichloroethene, antimony, arsenic, chromium, iron, manganese, and thallium.

Soil:

- Soil samples collected from the Construction Debris Area demonstrate the presence of polynuclear aromatic hydrocarbons (PAH's) and the metals aluminum, antimony, arsenic, copper, manganese, mercury, lead and nickel at concentrations that may be associated with CDA dumping activities. The volatile organic compounds 1,1-dichloroethane, benzene, ethylbenzene, and xylene were detected in one sample with no other site related volatile organic compounds reported.

Soil Gas:

- The soil vapor investigation that began in 1998 along the southern boundary of the landfill and CDA, and expanded in 1999, to assess the occurrence of volatile organic constituents in the soil gas along the southern and eastern perimeters of the landfill detected multiple organic volatiles (BTEX, chlorinated ethenes, chlorinated ethanes). The more elevated concentrations of all constituents were noted off the landfill, with a decreasing trend moving away from the landfill perimeter. The highest concentrations were measured in the southeast corner of the site northwest of the intersection of County Road 10 and John Weaver Parkway.

Potential Risk to Human Health:

- Ground water data collected from 1978 to 2000 was evaluated, for usability in the risk assessment, against criteria established in this report to ensure a consistent, defensible and representative data set. From this data set, total risk to residents living to the south of the Himco Dump from exposure to ground water for the southern perimeter was quantitatively evaluated using concentrations measured from the monitoring well pair MW116A/119A combined with the risk to exposure to soil associated with the CDA. Monitoring wells WT101A, WT114A, and WT114B and direct-push sampling points GP16, GP101 and GP114 were chosen to evaluate the risk to residents living to the east of the Himco Dump from exposure to ground water from the eastern perimeter of the landfill. Given the available data set, these wells represent the most contaminated area, both horizontally and vertically, of the ground water plume migrating from the landfill to the east and southeast.

- Samples taken from some of the residential wells east of the landfill exhibited concentrations of contaminants at, or higher than, concentrations found in monitoring wells. Some contaminant concentrations exceeded risk screening levels and/or MCLs.

- The results of the human health risk assessment indicate potential risk to the following receptors if exposed to soil within the CDA or ground water migrating south and east from of the site.

- Potential carcinogenic risk to residents within the CDA ranged from 3.2 in 10,000 (3.2E-04) to 4.5 in 10,000 (4.5E-04); ground water pathways contribute a risk of 3.0 in 10,000 (3.0E-04), with the remaining risk of 1.9 in 100,000 (1.9E-05) to 1.5 in 10,000 (1.5E-04) coming from soil pathways. Carcinogenic risk is due primarily to ingestion and dermal contact to arsenic, benzo(a)pyrene, and dibenz(a,h)anthracene in soil and from inhalation exposure to benzene and vinyl chloride, and ingestion of arsenic, benzene, 1,2-dichloropropane and vinyl chloride in ground water.

- Potential noncarcinogenic risk to residents within the CDA ranged from a HI of 46 to 50; ground water pathways contributed a HI of 46, with the remaining HI of 0.11 to 4.5 coming from soil pathways. Noncarcinogenic risk is primarily due to ingestion and dermal contact to antimony, arsenic, copper, manganese, and mercury in soil and from inhalation exposure to benzene and 1,2-dichloropropane, and ingestion of antimony, arsenic, iron, manganese, and thallium in ground water.

- The concentration of lead measured in the soil exceeded the residential screening level of 400 mg/kg in one location, but may underestimate the overall risk to lead in other locations because the CDA Land Parcel soils were not fully characterized and the total soil concentration measured did not account for the potential enrichment of lead in the fine particle fraction which sticks to hands and is ingested by children.

- Potential carcinogenic risk to the construction worker from exposure to soil slightly exceeded 1 in 1,000,000 (1E-06) in several CDA Land Parcels. Noncarcinogenic risk from incidental ingestion and dermal contact with soil that contains aluminum, antimony, arsenic, copper, manganese, mercury and nickel presented a hazard (HQ 1.3) in one Land Parcel. Contaminant concentrations in the CDA Land Parcels were not fully characterized.

- The potential carcinogenic risk to residents living east of the Himco Dump site was 5.8 in 10,000 (5.8E-04), and was predominately due to ingestion of arsenic and inhalation exposure to benzene in ground water.

- The potential noncarcinogenic risk to residents living east of the Himco Dump site has a hazard index (HI) of 29, with each target organ risk having a HI which exceeds 1. The noncarcinogenic risk is primarily due to inhalation exposure to benzene and 1,2-dichloropropane, and ingestion of arsenic, iron, manganese, and thallium in ground water.

11.2 Recommendations

The results of these investigations demonstrate the need for the development of remedial designs and remedial actions to 1) mitigate the continued migration of ground water and landfill gas contaminants into the paths of adjacent southern and eastern residential areas, and 2) to remove the potential for exposure to soil contaminants that present a human health risk.

Potential remedial options would include a landfill cover combined with an active landfill gas collection system. In addition, ground water controls should include long term monitoring of site ground water. Capping of the residential water supply wells combined with connection to a municipal water distribution system should be considered for residents located immediately to the east of the Himco Dump Site. Residents located to the south of the landfill have previously been provided with municipal water; however capping of remaining wells is recommended to prevent accidental use of ground water in this area. CDA soils have demonstrated a potential risk from repeated exposure and should be removed.

12.0 REFERENCES

Amdur, M.O., Doull, J., and Klaassen, C.D., Eds., 1991, *Casarett and Doull's Toxicology, The Basic Science of Poisons:* Fourth Edition, Pergamon Press.

Andelman, J.B., 1990, Total Exposure to Volatile Organic Compounds in Potable Water, Chapter 20, In *Significance and Treatment of Volatile Organic Compounds in Water Supplies:* (Ram, N.M., Christman, R.F., and Cantor, K.P., Eds.), Lewis Publishers, Chelsea MI, pp. 485-504.

Arihood, L.D., and Cohen, D.A., 1998, Geohydrology and Simulated Ground-Water Flow in Northwestern Elkhart County, Indiana: U.S. Geological Survey Water-Resources Investigations Report 97-4204, 47 pp.

Donohue, 1992, Himco Dump Remedial Investigation/Feasibility Study: SEC Donohue, Inc., September.

Duwelius, R.F., and Silcox, C.A., 1991, Ground-Water Levels, Flow, and Quality in Northwestern Elkhart County, Indiana, 1980-89: U.S. Geological Survey.

Fetter, C.W., 2001, *Applied Hydrogeology:* Fourth Edition, Prentice-Hall, Inc., 598 pp.

Freeze, A.R., and Cherry, J.A., 1979, *Groundwater:* Prentice-Hall, Inc., Englewood Cliffs, N.J.

IDNR, 1987, Water Resource Availability in the St. Joseph River Basin, Indiana, Indiana Department of Natural Resources Water Resource Assessment 87-1: 139 pp.

Imbrigiotta, T.E., and Martin Jr., A., 1981, Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana: U.S. Geological Survey, October.

Montgomery, J.H., 1991, *Groundwater Chemicals Desk Reference - Volume 2:* Lewis Publishers, Inc., Chelsea, MI, 944 pp.

Montgomery, J.H., and Welkom, L.M., 1990, *Groundwater Chemicals Desk Reference:* Lewis Publishers, Inc., Chelsea, MI, 640 pp.

NRC, 1989, *Recommended Dietary Allowance:* Tenth Edition, National Research Council, Washington, D.C., National Academy Press.

Skougstad and others, 1979, Methods for Determination of Inorganic Substances in Water and Fluvial Sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A1, 626 pp.

URS and GeoTrans, 2002, Second Remedial Design/Remedial Action Preliminary Design Report, Conrail Railyard Superfund Site, Elkhart, Indiana: Prepared for Settling Parties Conrail Superfund Site, January 2002, Prepared by URS Corporation, Cincinnati, Ohio and GeoTrans, Inc., Harvard, Massachusetts, variously paginated.

USACE, 1995, Himco Dump Superfund Site, Elkhart, Indiana, Final Work Plan For Pre-Design Field Activities: U.S. Army Corps of Engineers, Omaha District, July.

USACE, 1996, Final Pre-Design Technical Memorandum, Himco Dump Site, Elkhart, Indiana: U.S. Army Corps of Engineers, Omaha District, March.

USACE, 1998, 1) 100% Specifications, Himco Dump Site, Final Landfill Closure, Elkhart, Indiana: U.S. Army Corps of Engineers, Omaha District, April.

2) Plans for Remedial Action, Himco Dump Site, Elkhart, Indiana: U.S. Army Corps of Engineers, Omaha District, April.

3) 100% Design Analysis, Himco Dump Site, Final Landfill Closure, Elkhart, Indiana: U.S. Army Corps of Engineers, Omaha District, April.

4) 100% Post-Closure Operations, Maintenance and Monitoring Plan, Himco Dump Site, Final Landfill Closure, Elkhart, Indiana: U.S. Army Corps of Engineers, Omaha District, April.

USACE, 1998a, Field Sampling Plan for the Supplemental Field Investigation at the Himco Dump Superfund Site, Elkhart, Indiana: U.S. Army Corps of Engineers, Omaha District, Revision 0, October.

USACE, 1998b, Addendum to the Quality Assurance Project Plan for Field Activities at the Himco Dump Superfund Site, Elkhart, Indiana: U.S. Army Corps of Engineers, Omaha District, Revision 1, October.

USACE, 1998c, Site Specific Safety and Health Plan: U.S. Army Corps of Engineers, Omaha District, May.

USACE, 1998d, Risk Assessment Workplan for the Supplemental Field Investigation at the Himco Dump Superfund Site, Elkhart, Indiana: U.S. Army Corps of Engineers, Omaha District, October.

EPA, 1979, Part III-Guidelines for Establishing Test Procedures for the Analysis of Pollutants, Proposed Regulations: Federal Register, v. 44, no. 231, pp. 69463-69575.

EPA, 1985, Potential Hazardous Waste Site, Site Inspection Report: Ecology & Environment FIT, February 1985.

EPA, 1988a, Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses, February 1988: U.S. Environmental Protection Agency, Hazardous Site Evaluation Division.

EPA, 1988b, Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, July 1988: U.S. Environmental Protection Agency, Hazardous Site Evaluation Division.

EPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Washington, D.C.: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response.

EPA, 1991a, Risk Assessment Guidance for Superfund Volume I, Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors, Interim Final: Office of Solid Waste and Emergency Response, OSWER Directive 9285.6-03.

EPA, 1991b, Role of Baseline Risk Assessment in Superfund Remedy Selection Decisions: Office of Solid Waste and Emergency Response, OSWER Directive 9335.0-30, April.

EPA, 1992, Dermal Exposure Assessment, Principles and Applications, Interim Report: EPA/600/8-91/011B.

EPA, 1993, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons: U.S. Environmental Protection Agency, EPA/600/9-93/089, March.

EPA, 1994a, EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review: U.S. Environmental Protection Agency, EPA/540/R-94/013.

EPA, 1994b, EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review: U.S. Environmental Protection Agency, EPA/540/R-94/012.

EPA, 1994c, Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities: U.S. Environmental Protection Agency, OSWER Directive #9355.4-12.

EPA, 1994d, Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children: U.S. Environmental Protection Agency, EPA/540/R-93/081.

EPA, 1996a, Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil: U.S. Environmental Protection Agency, Technical Review Workgroup for Lead.

EPA, 1996b, Soil Screening Guidance Technical Background Document: Office of Solid Waste and Emergency Response, EPA/540/R-95/128, May.

EPA, 1997a, HEAST (Health Effects Assessment Summary Tables), FY-1997 Annual Update: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, EPA/540/R-97/036.

EPA, 1997b, Exposure Factors Handbook: Office of Research and Development, Washington, DC, EPA/600/P-95/002Fa, b, and c, August.

EPA, 1998, Clarification to the 1994 Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities: U.S. Environmental Protection Agency, OSWER Directive #9200.4-27P.

EPA, 2000a, Region 9 Preliminary Remediation Goals (PRGs) San Francisco, California [on line] U.S. Environmental Protection Agency, Region 9.

EPA, 2000b, TRW Recommendations for Sampling and Analysis of Soil at Lead (Pb) Sites: Office of Emergency and Remedial Response, EPA-540-F-00-010, April.

EPA, 2000c, IRIS (Integrated Risk Information System). Cincinnati, Ohio [on line]:U.S. Environmental Protection Agency, Environmental Criteria and Assessment Office.

EPA, 2002a, Drinking Water Advisory: Consumer Acceptability Advice and Health Effects analysis on Sodium, External Review Draft: U.S. Environmental Protection Agency, Office of Water, Health and Ecological Criteria Division, EPA 822-R-02-032, April.

EPA, 2002b, Blood Lead Concentrations of U.S. Adult Females: Summary Statistics from Phases 1 and 2 of the National Health and Nutrition Evaluation Survey (NHANES III): U.S. Environmental Protection Agency, Technical Review Workgroup for Lead, March.

Wester, R.C., H.I. Maibach, et al., 1993, In Vivo and In Vitro Percutaneous Absorption and Skin Decontamination of Arsenic from Water and Soil: Fundamental and Applied Toxicology, 20(3), 336-340.

Wiedemeier, T. H., Rifai, H.S., Newell, C.J., and Wilson, J.T., 1999,*Natural Attenuation of Fuels and Chlorinated Solvents in the Subsurface*, John Wiley and Sons, Inc., 617 pp.

Tables

Table 2-1
Summary of Monitoring Well Sampling Events
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Well ID Number	4-5/1978 USGS	10/1978 USGS	4-5/1979 USGS	9/1979 USGS	11-12/1980 USGS	8/1982 USGS	7/1983 USGS	7-8/1984 E&E	7/1984 USGS	8/1985 USGS	7/1986 USGS	8/1987 USGS	8/1988 USGS	8/1989 USGS	11/90-1/91 Donahue	9/1991 Donahue	9/1992 USGS	9/1995 USACE	11/1996 USEPA	10/1998 USACE	3/2000 USEPA[2]	4-5/2000 USACE	11/2000 USGS
WTB1	M*,I*	M*,I*	M,I,Pe	M,I,Pe	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	I,V,S,P[3],Q	ns	ns	ns	ns	ns	I*,V,S,Br*	I*,V,S,Br*	ns
WTB2	M*,I*	M*,I*	M,I,Pe	M,I,Pe	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	I,V,S,P,Q	I,V,S,P,Q	ns	ns	ns	ns	ns	ns	ns
WTB3	M*,I*	M*,I*	M,I,Pe	M,I,Pe	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	I,V,S,P,Q	I,V,S,P,Q	ns	ns	ns	ns	I*,V,S,Br*	I*,V,S,Br*	ns
WTB4	M*,I*	M*,I*	M,I,Pe	M,I,Pe	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	I,V,S,P,Q	I,V,S,P,Q	ns	ns	ns	ns	Br*	I*,V,S,Br*	ns
WTC1	M*,I*	M*,I*	M,I,Pe	M,I,Pe	ns	ns	ns	ns	ns	ns	destroyed	----	----	----	----	----	----	----	----	----	----	----	---->
WTC2	M*,I*	M*,I*	M,I,Pe	M,I,Pe	ns	ns	ns	ns	ns	ns	destroyed	----	----	----	----	----	----	----	----	----	----	----	---->
WTC3	M*,I*	M*,I*	M,I,Pe	M,I,Pe	ns	ns	ns	ns	ns	ns	destroyed	----	----	----	----	----	----	----	----	----	----	----	---->
WTC4	M*,I*	M*,I*	M,I,Pe	M,I,Pe	ns	ns	ns	ns	ns	ns	destroyed	----	----	----	----	----	----	----	----	----	----	----	---->
WTCP1	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	I,V,S,P,Q	I,V,S,P,Q	ns	Abandoned 8/95 by USACE		----	----	----	---->
WTD1	M*,I*	M*,I*	M,I	M,I,Pe	B	B	B,U	I,V,S,P	B	B	B	B	B	B	ns	ns	B	ns	ns	ns	ns	ns	ns
WTD2	M*,I*	M*,I*	M,I	M,I,Pe	B	B	B,U	I,V,S,P	B	B	B	B	B	B	ns	ns	B	ns	ns	ns	ns	ns	ns
WTD3	M*,I*	M*,I*	M,I	M,I,Pe	B	B	B,U	ns	B	B	B	B	B	B	ns	ns	B	ns	ns	ns	ns	ns	ns
WTD4	?	?	?	?	?	Abandoned 1/81 by USGS				----	----	----	----	----	----	----	----	----	----	----	----	----	---->
WTE1	M*,I*	M*,I*	M,I,Pe,V,S	M,I,Pe	B	B	B,U	ns	B	B	B	B	B	B	ns	ns	B	V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WTE2	M*,I*	M*,I*	M,I,Pe,V,S	M,I,Pe	B	B	B,U	I,V,S,P	B	B	B	B	B	B	I,V,S,P,Q	I,V,S,P,Q	B	Abandoned 8/95 by USACE		----	----	----	---->
WTE3	M*,I*	M*,I*	M,I,Pe,V,S	M,I,Pe	B	B	B,U	I,V,S,P	B	B	B	B	B	B	I,V,S,P,Q	ns	B	ns	ns	ns	I*,V,S,Br*	I*,V,S,Br*	ns
WTF1	M*,I*	M*,I*	M,I,Pe	M,I,Pe	B	B	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	Abandoned 3/91by USGS			----	----	----	----	---->
WTF2	M*,I*	M*,I*	M,I,Pe	M,I,Pe	B	B	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	Abandoned 3/91by USGS			----	----	----	----	---->
WTF3	M*,I*	M*,I*	M,I,Pe	M,I,Pe	ns	Abandoned 1/81 by USGS				----	----	----	----	----	----	----	----	----	----	----	----	----	---->
WTF4	ns	ns	M,I,Pe	M,I,Pe	ns	Abandoned 1/81 by USGS				----	----	----	----	----	----	----	----	----	----	----	----	----	---->
WTF5	M*,I*	M*,I*	M,I,Pe	M,I,Pe	B	B	B	ns	B	B	B	B	B	B	I,V,S,P,Q	Abandoned 3/91by USGS			----	----	----	----	---->
WTG1	M*,I*	M*,I*	ns	ns	B	ns	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	ns	B	ns	ns	ns	V,Br*	I*,V,S,Br*	ns
WTG2	M*,I*	M*,I*	ns	ns	ns	Abandoned 1/81 by USGS				----	----	----	----	----	----	----	----	----	----	----	----	----	---->
WTG3	M*,I*	M*,I*	ns	ns	B	ns	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	ns	B	ns	ns	ns	V,Br*	I*,V,S,Br*	ns
WTI1	M*,I*	M*,I*	M,I,Pe	M,I,Pe	B	B	B,U	I,V,S,P	B	B	B	B	B	B	I,V,S,P,Q	ns	B	ns	ns	ns	Unable to locate		---->
WTI2	M*,I*	M*,I*	M,I,Pe	M,I,Pe	B	B	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	ns	B	ns	ns	ns	Unable to locate		---->
WTI3	M*,I*	M*,I*	M,I,Pe	M,I,Pe	B	B	B,U	I,V,S,P	B	B	B	B	B	B	I,V,S,P,Q	ns	B	ns	ns	ns	Unable to locate		---->
WTI4	?	?	?	?	?	Abandoned 1/81 by USGS				----	----	----	----	----	----	----	----	----	----	----	----	----	---->
WTJ1	M*,I*	M*,I*	ns	ns	B	B	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	ns	B	ns	ns	ns	V,Br*	ns	ns
WTJ2	M*,I*	M*,I*	ns	ns	B	B	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	ns	B	ns	ns	ns	ns	ns	ns
WTJ3	M*,I*	M*,I*	ns	ns	B	B	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	ns	B	ns	ns	ns	V,SO_4	ns	ns
WTK1	M*,I*	M*,I*	ns	ns	B[4]	B	B,U	ns	B[5]	B	B	B	B	B	ns	ns	B	ns	ns	ns	ns	ns	ns
WTK2	M*,I*	M*,I*	ns	ns	B	B	B,U	ns	B	B	B	B	B	B	ns	ns	B	ns	ns	ns	ns	ns	ns
WTK3	M*,I*	M*,I*	ns	ns	B[4]	B	B,U	ns	B[5]	B	B	B	B	B	ns	ns	B	ns	ns	ns	ns	ns	ns

Table 2-1
Summary of Monitoring Well Sampling Events
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Well ID Number	4-5/1978 USGS	10/1978 USGS	4-5/1979 USGS	9/1979 USGS	11-12/1980 USGS	8/1982 USGS	7/1983 USGS	7-8/1984 E&E	7/1984 USGS	8/1985 USGS	7/1986 USGS	8/1987 USGS	8/1988 USGS	8/1989 USGS	11/90-1/91 Donahue	9/1991 Donahue	9/1992 USGS	9/1995 USACE	11/1996 USEPA	10/1998 USACE	3/2000 USEPA[2]	4-5/2000 USACE	11/2000 USGS
WTM1	---------->	Installed 5/79	M*,I	M,I,V,S,Pe	B	B	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	I,V,S,P,Q	B	Abandoned 8/95 by USACE		----------	----------	----------	---------->
WTM2	---------->	Installed 5/79	M,I	M,I,V,S,Pe	B	B	B,U	I,V,S,P	B	B	B	B	B	B	I,V,S,P,Q	I,V,S,P,Q	B	Abandoned 8/95 by USACE		----------	----------	----------	---------->
WTN1	---------->	Installed 4/79	M,I,Pe	M,I,Pe	B	B	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	ns	B	ns	ns	ns	ns	ns	ns
WTO1	---------->	Installed 5/79	M,I,Pe	M,I,Pe	B	B	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	ns	B	I,V,S,P	ns	ns	ns	ns	ns
WTP1	---------->	Installed 5/79	M,I,Pe	M,I,Pe	B	B	B,U	I,V,S,P	B	B	B	B	B	B	ns	I,V,S,P,Q	B	Abandoned 8/95 by USACE		----------	----------	----------	---------->
WTQ1	---------->	Installed 4/79	M,I,Pe	M,I,Pe	B	B	B,U	ns	B	B	B	B	B	B	I,V,S,P,Q	ns	ns	ns	ns	ns	ns	ns	ns
WT101A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 11/90	I,V,S,P,Q	I,V,S,P,Q	ns	I,V,S,P	ns	I,V,S	ns	I*,V,S,Br*	V,S,P,I,C,E
WT101B	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 12/90	I,V,S,P,Q	I,V,S,P,Q	ns	I,V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WT101C	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 12/90	I,V,S,P,Q	I,V,S,P,Q	ns	ns	ns	ns	ns	I*,V,S,Br*	ns
WT102A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 11/90	I,V,S,P,Q[1]	I,V,S,P,Q	ns	I,V,S,P	ns	I,V,S	ns	I*,V,S,Br*	ns
WT102B	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 12/90	I,V,S,P,Q	I,V,S,P,Q	ns	I,V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WT102C	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 12/90	I,V,S,P,Q	I,V,S,P,Q	ns	ns	ns	ns	ns	I*,V,S,Br*	ns
WT103A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 11/90	I,V,S,P,Q	I,V,S,P,Q	ns	ns	ns	ns	ns	ns	ns
WT104A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 11/90	I,V,S,P,Q	I,V,S,P,Q	ns	ns	ns	ns	ns	ns	ns
WT105A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 11/90	I,V,S,P,Q[1]	I,V,S,P,Q	ns	ns	I*,V,S	ns	ns	I*,V,S,Br*	ns
WT106A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 11/90	I,V,S,P,Q[1]	I,V,S,P,Q	ns	ns	I*,V,S	ns	ns	I*,V,S,Br*	ns
WT111A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 9/91	I,V,S,P,Q	ns	I,V,S,P	I*,V,S	ns	ns	I*,V,S,Br*	ns
WT112A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	I,V,S,P	ns	I,V,S	ns	I*,V,S,Br*	ns
WT112B	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	I,V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WT113A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	I,V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WT113B	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	I,V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WT114A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	I,V,S,P	ns	I,V,S	ns	I*,V,S,Br*	ns
WT114B	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	I,V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WT115A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	I,V,S,P	I*,V,S	I,V,S	ns	I*,V,S,Br*	ns
WT116A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	I,V,S,P	V	I,V,S	ns	I*,V,S,Br*	V,S,P,I,C,E
WT116B	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	I,V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WT117A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WT117B	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WT118B	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 8/95	ns	I,V,S,P	ns	ns	ns	I*,V,S,Br*	ns
WT119A	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------->	Installed 10/98	I,V,S	ns	I*,V,S,Br*	ns

NOTES: B = Bromide, Alkalinity and Carbon Dioxide
Br = Bromide
Br* = Bromide, Sulfate
C = Bromide, Sulfate and Chloride
E = Emerging Contaminants
I = Inorganic Compounds (Metals and Cyanide)
I* = Metals only (No Cyanide analysis)
M = Major Ions
M* = Major Ions (No Bromide)
ns = Not Sampled
P = PCB's/Pesticides
Pe = Phenols, total
Q = Water Quality as defined by Donahue (Alkalinity, Bromide, COD, Chloride, Ammonia, Nitrate + Nitrite, Sulfate, TDS, Total Kjeldahl Nitrogen, Phosphorus, TSS)
S = Semi-Volatile Organic Compounds (Acid/Base/Neutral Extractables)
SO_4 = Sulfate
U = Sulfate, Sodium and Potassium
V = Volatile Organic Compounds

1. Sampled both 11/1990 and 1/1991.
2. Sampling performed immediately after completion of well development with development pump/hoses.
3. Bolded compounds indicate the analytical data may be used in a quantitative risk assessment.
4. Sampled both 3/1980 and 12/1980.
5. Sampled both 7/1984 and 12/1984.

Table 2-2
Summary of Residential Well Sampling Events
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Well ID Number	October 1990 Donahue	March 2000 USEPA	April 2000 USACE	November 2000 USGS
RW-01	**V,S,P,I,Q**	ns	ns	ns
RW-02	**V,S,P,I,Q**	ns	ns	ns
RW-03	**V,S,P,I,Q**	ns	ns	ns
RW-04	**V,S,P,I,Q**	ns	ns	ns
RW-05	**V,S,P,I,Q**	ns	ns	ns
RW-06	**V,S,P,I,Q**	ns	ns	ns
RW-07	**V,S,P,I,Q**	ns	ns	ns
RW-08	**V,S,P,I,Q**	ns	ns	ns
RW-12	ns	**V,S,I*,U**	**V,S,I*,Br***	ns
RW-13	ns	**V,S,I*,U**	**V,S,I*,Br***	ns
RW-14	ns	**V,S,I*,U**	**V,S,I*,Br***	ns
RW-15	ns	**V,S,I*,Br***	**V,S,I*,Br***	ns
RW-16	ns	**V,S,I*,Br***	**V,S,I*,Br***	ns
RW-17	ns	**V,S,I*,U**	**V,S,I*,Br***	ns
RW-18	ns	**V,S,I*,Br***	**V,S,I*,Br***	ns
RW-19	ns	**V,S,I*,Br***	**V,S,I*,Br***	ns
RW-20	ns	**V,S,I*,Br***	**V,S,I*,Br***	ns
RW-21	ns	**V,S,I*,U**	**V,S,I*,Br***	ns
RW-22	ns	**V,S,I*,Br***	**V,S,I*,Br***	**V,S,P,I,C,E**
RW-23	ns	ns	**V,S,I*,Br***	ns
RW-24	ns	ns	ns	**V,S,P,I,C**

Br* = Bromide, Sulfate by CRL
C = Bromide, Sulfate and Chloride by CRL
E = Emerging Contaminants
I = Inorganic Compounds (Metals and Cyanide)
I* = Metals only (No Cyanide analysis)
ns = Not Sampled
P = PCB's/Pesticides
Q = Water Quality as defined by Donohue (Alkalinity, Bromide, COD, Chloride, Ammonia, Nitrate + Nitrite, Sulfate, TDS, Total Kjeldahl Nirogen, Phosphorous, TSS)
S = Semi-Volatile Organic Compounds (Acid/Base/Neutral Extractables)
U = Sulfate by Hach Spectrophotometer
V = Volatile Organic Compounds

Bolded compounds indicate the analytical data may be used in a quantitative risk assessment.

Table 2-3
Ground Water Monitoring Well Construction Details
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Well ID Number[1]	Date Installed	Screen Length[2]	Casing Material	Casing Diameter[3]	Installed Depth[4]	Northing	Easting	Well Elevation[5]
WTB1	10/06/77	6.0	PVC	5	473.0	1533596.77	405953.28	763.65
WTB2	11/03/77	10.0	Black Steel	2	11.9	1533597.11	405959.05	763.18
WTB3	10/17/77	10.0	PVC	5	135.0	1533597.39	405968.13	763.28
WTB4	10/07/77	5.0	PVC	5	173.0	1533595.28	405975.91	762.33
WTC1	10/04/77	5.0	PVC	5	342.0	N/A[6]	N/A[6]	N/A[6]
WTC2	11/03/77	10.0	N/A	2	12.5	N/A[6]	N/A[6]	N/A[6]
WTC3	10/05/77	5.0	PVC	5	197.0	N/A[6]	N/A[6]	N/A[6]
WTC4	10/05/77	10.0	PVC	5	130.0	N/A[6]	N/A[6]	N/A[6]
WTCP1	N/A	N/A	N/A	N/A	N/A	N/A[6]	N/A[6]	N/A[6]
WTD1	10/13/77	10.0	Black Steel	2	19.3	N/A[6]	N/A[6]	N/A[6]
WTD2	10/03/77	5.0	PVC	5	176.0	N/A[6]	N/A[6]	N/A[6]
WTD3	10/03/77	10.0	PVC	5	90.0	N/A[6]	N/A[6]	N/A[6]
WTD4	09/27/77	3.0	N/A	2	29.9	N/A[6]	N/A[6]	N/A[6]
WTE1	10/11/77	10.0	PVC	5	81.0	1531566.72	407131.36	765.75
WTE2	11/03/77	10.0	Black Steel	2	17.4	N/A[6]	N/A[6]	N/A[6]
WTE3	10/11/77	5.0	PVC	5	176.0	1531548.54	407126.66	765.47
WTF1	10/13/77	10.0	PVC	2	31.5	N/A[6]	N/A[6]	N/A[6]
WTF2	10/12/77	5.0	PVC	5	155.0	N/A[6]	N/A[6]	N/A[6]
WTF3	11/03/77	10.0	N/A	2	14.7	N/A[6]	N/A[6]	N/A[6]
WTF4	09/28/77	2.5	N/A	2	23.5	N/A[6]	N/A[6]	N/A[6]
WTF5	10/11/77	10.0	PVC	5	198.0	N/A[6]	N/A[6]	N/A[6]
WTG1	10/17/77	5.0	PVC	5	52.0	N/A[6]	N/A[6]	763.23
WTG2	11/02/77	10.0	N/A	2	16.3	N/A[6]	N/A[6]	N/A[6]
WTG3	10/17/77	10.0	PVC	5	172.0	N/A[6]	N/A[6]	763.37
WTI1	10/13/77	5.0	PVC	5	168.0	N/A[6]	N/A[6]	N/A[6]
WTI2	11/03/77	10.0	Black Steel	2	15.4	N/A[6]	N/A[6]	N/A[6]
WTI3	10/13/77	5.0	PVC	5	37.0	N/A[6]	N/A[6]	N/A[6]
WTI4	09/28/77	2.5	N/A	2	24.2	N/A[6]	N/A[6]	N/A[6]
WTJ1	10/12/77	5.0	PVC	5	40.0	N/A[6]	N/A[6]	N/A[6]
WTJ2	11/02/77	10.0	Black Steel	2	17.8	N/A[6]	N/A[6]	N/A[6]
WTJ3	10/12/77	5.0	PVC	5	154.0	N/A[6]	N/A[6]	N/A[6]
WTK1	10/13/77	5.0	PVC	5	62.0	N/A[6]	N/A[6]	N/A[6]
WTK2	11/02/77	10.0	Black Steel	2	14.6	N/A[6]	N/A[6]	N/A[6]
WTK3	10/13/77	5.0	PVC	5	185.0	N/A[6]	N/A[6]	N/A[6]
WTM1	05/03/79	5.0	Galvanized Steel	2	103.6	N/A[6]	N/A[6]	N/A[6]
WTM2	05/02/79	5.0	PVC	2	25.2	N/A[6]	N/A[6]	N/A[6]
WTN1	04/30/79	5.0	PVC	2	30.0	N/A[6]	N/A[6]	N/A[6]
WTO1	05/01/79	5.0	PVC	2	30.0	1532407.14	407876.93	762.83
WTP1	05/03/79	5.0	PVC	2	25.0	N/A[6]	N/A[6]	N/A[6]
WTQ1	04/26/79	5.0	PVC	2	25.0	N/A[6]	N/A[6]	N/A[6]

Table 2-3
Ground Water Monitoring Well Construction Details
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Well Number[1]	Date Installed	Screen Length[2]	Casing Material	Casing Diameter[3]	Installed Depth[4]	Northing	Easting	Well Elevation[5]
WT101A	11/12/90	10.0	Stainless Steel	2	16.3	1531629.81	407616.98	764.34
WT101B	12/14/90	5.0	Stainless Steel	2	98.0	1531617.03	407621.69	764.23
WT101C	12/12/90	5.0	Stainless Steel	2	165.0	1531603.13	407627.48	764.11
WT102A	N/A	10.0	Stainless Steel	2	16.0	1534850.57	405943.64	769.09
WT102B	12/02/90	5.0	Stainless Steel	2	65.4	1534872.79	405939.79	768.82
WT102C	12/01/90	5.0	Stainless Steel	2	159.5	1534862.86	405941.85	769.20
WT103A	11/11/90	10.0	Stainless Steel	2	16.0	1532537.59	405538.04	762.61
WT104A	11/12/90	10.0	Stainless Steel	2	16.3	1531495.73	406017.3	765.29
WT105A	11/10/90	10.0	Stainless Steel	2	16.0	1531172.44	407102.56	762.58
WT106A	11/09/90	10.0	Stainless Steel	2	16.3	1530938.53	407760.41	761.50
WT111A	09/10/91	10.0	Stainless Steel	2	20.0	1531905.43	406358.78	766.45
WT112A	08/23/95	10.0	PVC	2	15.4	1533653.49	406824.67	765.90
WT112B	08/23/95	5.0	PVC	2	59.4	1533653.01	406834.06	766.09
WT113A	08/10/95	10.0	PVC	2	21.7	1533608.69	407789.11	771.85
WT113B	08/10/95	5.0	PVC	2	67.2	1533604.43	407779.02	772.06
WT114A	08/21/95	10.0	PVC	2	22.0	1531843.97	407997.29	769.19
WT114B	08/22/95	5.0	PVC	2	65.3	1531834.38	407995.71	769.37
WT115A	08/22/95	10.0	PVC	2	17.4	1531675.84	407261.44	765.87
WT116A	08/17/95	10.0	PVC	2	12.6	1531925.50	406784.96	763.86
WT116B	08/17/95	5.0	PVC	2	58.4	1531931.04	406775.79	763.89
WT117A	08/15/95	10.0	PVC	2	15.5	1532201.98	405908.93	767.19
WT117B	08/14/95	5.0	PVC	2	61.3	1532202.51	405896.41	766.60
WT118B	08/18/95	5.0	PVC	2	62.5	1531917.55	406361.16	766.49
WT119A	10/14/98	10.0	PVC	2	17.5	1531622.32	406737.59	763.26

1. USGS monitoring wells B1 through Q1, and CP1 have been redesignated by adding a "WT" to the beginning of each well number (i.e. Well A1 is redesignated WTA1).
2. Measured in feet. Does not include bottom cap.
3. Measured in inches.
4. Measured in feet from ground surface. Data for USGS wells WTB1 through WTQ1 obtained primarily from Table No. 1 of Duwelius and Silcox, 1991 and from Water Well Records filed with the State of Indiana. Data for wells WT101A through WT119A obtained from their respective well construction diagrams. The installed depth is measured from ground surface to the bottom of the screen and may not include the bottom cap.
5. Measured in feet Mean Sea Level (MSL).
6. State plane coordinates/well casing elevation data not available. Monitoring well has either been abandoned or has not been recently surveyed.

PVC - Polyvinyl Chloride
N/A - Not Available

Table 2-4
Surveying Data
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location Designation	Northing	Easting	Top of Riser Elevation[1]	Ground Elevation[1]
SB03	1532243.47	406108.58	NA[2]	761.12
SB04	1532175.57	406141.28	NA	761.78
SB05	NR[3]	NR	NR	NR
SB06	1532140.94	406203.37	NA	762.06
SB07	1532109.25	406402.68	NA	762.88
SB08	1532112.33	406338.49	NA	762.50
SB09	1532093.97	406453.51	NA	763.64
SB10	1532012.12	406384.44	NA	763.08
SB11	1532063.68	406534.46	NA	763.46
SB12	1532034.83	406507.75	NA	763.29
SB13	1531967.63	406512.80	NA	764.16
SB14	1531959.49	406462.81	NA	764.42
SB15	1532007.14	406640.10	NA	763.27
SB16	1532063.95	406665.69	NA	763.17
SB17	1532023.94	406714.51	NA	762.29
SB18	1531861.55	406770.36	NA	761.61
SB19	1531877.38	406862.70	NA	761.72
SB20	1531779.16	406776.18	NA	763.10
WT119A	1531622.32	406737.59	763.26	761.20
TT-11	1532290.48	405909.20	NA	763.39
TT-12	1532222.89	406070.52	NA	762.04
TT-13	1532175.46	406218.66	NA	762.25
TT-14	1532073.18	406449.78	NA	763.40
TT-15	1532003.36	406665.80	NA	762.73
TT-16	NR	NR	NR	NR
TT-17	1531824.30	406991.80	NA	761.50
TT-18	1531696.11	407165.33	NA	761.60
TT-19	1531644.60	407373.70	NA	762.30
TT-20	1531641.63	407563.52	NA	763.17
TT-21	1531667.42	407766.36	NA	762.44
TT-22	1531899.68	407891.22	NA	766.68
TT-23	1532071.88	407891.75	NA	766.75
TT-24	1532233.33	407894.02	NA	765.98
TT-25	1532399.04	407891.01	NA	764.72
TT-26	1531613.43	407793.99	NA	761.12
TT-27	1531606.96	407716.82	NA	761.79
TT-28	1531582.47	407404.29	NA	761.88
TT-29	1531591.46	407304.73	NA	763.12
TT-30	1531624.63	407199.35	NA	761.93
TT-31	1531616.56	4070092.15	NA	758.41
TT-32	1532082.29	406233.65	NA	762.48
TT-33	1532143.98	406150.10	NA	762.00
TT-34	NR	NR	NR	NR
TT-54	1531425.60	407738.06	NA	761.09
TT-55	1531321.00	407719.56	NA	761.52
TT-56	1531614.22	407792.12	NA	761.18
TT-57	1531462.97	407781.69	NA	760.70
TT-58	1531402.27	407817.26	NA	761.25
TT-59	1531297.87	407800.03	NA	761.27
TT-60	1531430.53	407858.63	NA	760.90
TT-61	1531577.11	407871.83	NA	762.18
TT-62	1531726.12	407875.02	NA	762.34
TT-63	1531872.00	407875.84	NA	764.42
TT-64	1532019.72	407876.36	NA	765.83
TT-65	1532168.78	407875.02	NA	766.17

Table 2-4
Surveying Data
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location Designation	Northing	Easting	Top of Riser Elevation[1]	Ground Elevation[1]
TT-66	1532311.32	407870.83	NA	764.69
TT-67	1532466.86	407866.75	NA	761.80
TT-68	1532628.69	407854.37	NA	762.51
TT-69	1532756.10	407861.17	NA	763.44
TT-70	1532245.57	407814.94	NA	762.14
TT-71	1532389.00	407806.22	NA	761.52
TT-72	1532532.19	407782.06	NA	762.13
TT-73	1532681.02	407787.88	NA	756.00
TT-74	1531277.44	407871.67	NA	761.39
TT-75	1531403.51	407956.33	NA	761.51
TT-76	1531513.48	407964.79	NA	760.54
TT-77	1531648.09	407962.04	NA	763.72
TT-78	1531796.67	407966.97	NA	766.49
TT-79	1531946.56	407968.25	NA	766.46
TT-80	1532095.19	407971.78	NA	765.44
TT-81	1532244.63	407973.64	NA	765.18
TT-82	1532393.85	407964.98	NA	765.66
TT-83	1532548.52	407958.80	NA	766.18
TT-84	1532691.69	407960.78	NA	767.22
TT-85	1532839.65	407950.42	NA	768.27
TT-86	1531554.82	408023.19	NA	760.95
TT-87	1531741.96	408019.95	NA	764.72
TT-89	1532016.36	408016.33	NA	766.24
TT-90	1532156.74	408013.31	NA	764.76
TT-91	1532294.20	408018.94	NA	765.60
TT-92	1532464.91	408009.77	NA	766.61
TT-95	1532815.28	408030.83	NA	768.65
TT-96	1531594.28	408129.39	NA	763.09
TT-97	1531718.47	408121.95	NA	764.42
TT-98	1531803.22	408136.61	NA	764.72
TT-100	1532020.99	408098.11	NA	765.16
TT-101	1532124.26	408098.46	NA	764.43
TT-102	1531353.41	407974.78	NA	760.67

1 Feet Mean Sea Level (MSL)
2 NA=Not Applicable
3 NR=Not Read

Table 3-1
Results from April 2000 Site-Wide Ground Water Survey
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Well Number	Date/Time	Casing Elevation[1]	Water Level[2]	Ground Water Elevation[1]	Vertical Gradient[4]
WTB1	4-20-00 1302	763.65	8.03	755.62	WTB1/WTB3 $+1.75 \times 10^{-4}$
WTB2	4-20-00 1305	763.18	Dry	N/A[3]	
WTB3	4-20-00 1324	763.28	7.72	755.56	
WTB4	N/A	762.33	N/A	N/A	
WTE1	4-20-00 1816	765.75	13.26	752.49	WTE1/WTE3 $+1.50 \times 10^{-3}$
WTE3	4-20-00 1826	765.47	12.83	752.64	
WTG1	4-19-00 1635	763.23	13.37	749.86	WTG1/WTG3 -3.69×10^{-2}
WTG3	4-19-00 1647	763.37	18.09	745.28	
WTO1	N/A	762.83	N/A	N/A	Not calculated
WT101A	4-20-00 1743	764.34	11.89	752.45	WT101A/WT101B $+1.56 \times 10^{-3}$
WT101B	4-20-00 1743	764.23	11.65	752.58	WT101B/WT101C $+1.34 \times 10^{-3}$
WT101C	4-20-00 1743	764.11	11.44	752.67	
WT102A	4-20-00 0800	769.09	12.20	756.89	WT102A/WT102B -2.17×10^{-3}
WT102B	4-20-00 0800	768.82	12.04	756.78	WT102B/WT102C $+1.06 \times 10^{-4}$
WT102C	4-20-00 0800	769.20	12.41	756.79	
WT103A	4-20-00 1354	762.61	7.00	755.61	Not calculated
WT104A	4-19-00 1146	765.29	13.44	751.85	
WT105A	4-19-00 1432	762.58	11.10	751.48	
WT106A	4-19-00 1505	761.50	9.98	751.52	
WT111A	4-20-00 1509	766.45	13.59	752.86	
WT112A	4-20-00 0920	765.90	10.67	755.23	WT112A/WT112B -2.17×10^{-4}
WT112B	4-20-00 0920	766.09	10.87	755.22	
WT113A	4-20-00 0941	771.85	17.21	754.64	WT113A/WT113B -2.10×10^{-4}
WT113B	4-20-00 0944	772.06	17.43	754.63	
WT114A	4-20-00 1700	769.19	16.63	752.56	WT114A/WT114B $+3.25 \times 10^{-3}$
WT114B	4-20-00 1700	769.37	16.66	752.71	
WT115A	4-20-00 1806	765.87	13.39	752.48	Not calculated
WT116A	4-20-00 1530	763.86	10.27	753.59	WT116A/WT116B -8.82×10^{-3}
WT116B	4-20-00 1530	763.89	10.70	753.19	
WT117A	4-20-00 1426	767.19	14.20	752.99	WT117A/WT117B $+2.92 \times 10^{-3}$
WT117B	4-20-00 1430	766.60	13.48	753.12	
WT118B	4-20-00 1515	766.49	13.57	752.92	Not calculated
WT119A	4-20-00 1858	763.26	10.68	752.58	

1. Measured in feet mean sea level.
2. Measured in feet from top of casing.
3. N/A - not available.
4. Measured in feet/feet.
   + indicates potential for upward flow.
   - indicates potential for downward flow.

Table 3-2
Monitoring Well Ground Water Analytical Detections Summary - November 1996
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	WT105A		WT111A		WT111A Dup		WT106A		WT115A		WT116A	
Sample number	MEAKN2		MEAKN3		MEAKN4		MEAKN5		MEAKN7			
Date sampled	11/13/1996		11/13/1996		11/13/1996		11/13/1996		11/13/1996		11/13/1996	
Units	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
TOTAL METALS												
Aluminum	17.0	U	280.0		267		50.8		32.0		NS	
Arsenic	3.0	U	3.7		3.10		5.60		3.0	U	NS	
Barium	5.4		105		107		101		33.3		NS	
Calcium	38000		8160		8220		146000		215000		NS	
Chromium	1.0	U	1.8		1.5		1.0	U	2.9		NS	
Cobalt	1.0	U	6.4		6.5		1.0	U	1.6		NS	
Copper	1.0	U	3.3		3.0		1.0	U	1.8		NS	
Iron	13.1		4470		4360		6080		2220		NS	
Lead	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	NS	
Magnesium	10200		2980		2980		18100		36000		NS	
Manganese	5.0		335		333		394		276		NS	
Nickel	1.0	U	7.2		7.2		1.8		3.8		NS	
Potassium	1760		1600		1620		4280		6520		NS	
Sodium	4460	J	3200		3270	J	25800	J	33600	J	NS	
Thallium	20.00	U	3.00		2.60		2.90		2.20		NS	
Vanadium	1.0	U	2.4		2.4		1.0	U	7.6		NS	
Zinc	3.6	J	22.2	J	21.2	J	2.9	J	4.1	J	NS	
Cyanide	NS		NS		NS		NS		NS		NS	
VOLATILE ORGANICS												
Sample number	EAXX9		EAXY0		EAXY1		EAXY2		EAXY4		EAXY5	
1,1-Dichloroethane	10	U	10	U	10	U	10	U	10	U	5	J
total 1,2-Dichloroethene	10	U	10	U	10	U	3	J	10	U	0.4	J
1,2-Dichloropropane	10	U	10	U	10	U	10	U	10	U	2	J
Benzene	10	U	10	U	10	U	10	U	2	J	7	J
SEMIVOLATILE ORGANICS												
Sample number	EAXX9		EAXY0		EAXY1		EAXY2		EAXY4		EAXY5	
bis(2-Ethylhexyl)phthalate	10	U	10	U	10	J	10	U	10	U	NS	

U: Analyte not detected
J: Value is an estimated concentration
NS: Not sampled

Table 3-3
Monitoring Well Ground Water Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	WT101A		WT101A dup		WT102A		WT112A		WT114A		WT115A		WT116A		WT119A		WT119A dup	
Date sampled	10/21/1998		10/21/1998		10/19/1998		10/20/1998		10/20/1998		10/21/1998		10/21/1998		10/22/1998		10/22/1998	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS																		
Aluminum	26.0	U	26.0	U	**27.6**	J	26.0	UJ	26.0	UJ	**94.1**	J	**58.0**	J	**258**	J	**249**	J
Antimony	42.2	U	42.2	U	42.2	UJ	42.2	UJ	42.2	UJ	42.2	U	42.2	UJ	43.2	UB	42.2	U
Arsenic	**3.6**	J	**3.3**	J	0.90	UJ	0.90	UJ	**24.3**	J	**0.90**		**1.0**	J	**5.8**	J	**5.3**	
Barium	**91.2**	J	**85.5**	J	**47.3**	J	**36.6**	J	**238**	J	33.5	UJ	**192**	J	**78.3**		**76.0**	
Beryllium	0.60	U	0.60	U	0.60	UJ	0.60	UJ	**0.60**	J	0.60	U	0.60	UJ	0.60	UJ	0.60	UJ
Calcium	**377000**		**361000**		**17100**	J	**19000**	J	**27000**	J	**293000**		**60900**	J	**143000**		**142000**	
Chromium	**13.1**		**11.3**		**20.3**	J	**7.5**	J	**12.0**	J	**10.4**		7.0	UJ	**7.8**		7.0	U
Cobalt	7.8	U	7.8	U	7.8	UJ	7.8	UJ	**11.9**	J	7.8	U	7.8	UJ	7.8	U	7.8	U
Copper	4.1	U	4.1	U	4.1	UJ	4.1	UJ	4.1	UJ	4.1	U	4.1	UJ	**5.4**		**4.9**	
Iron	**28100**		**26900**		**96.8**	J	11.7	UJ	**17900**	J	**4590**		**4490**	J	**1690**		**1690**	
Lead	0.50	U	0.50	U	0.50	UJ	0.50	UJ	0.50	UJ	0.50	U	0.50	UJ	**3.4**	J	**2.4**	J
Magnesium	**14700**		**13900**		**16600**	J	**14000**	J	**24800**	J	**20300**		**52700**	J	**44800**		**44500**	
Manganese	**3080**		**2940**		**61.5**	J	**6.7**	J	**306**	J	**513**		**662**	J	**279**		**278**	
Mercury	0.10	U	0.10	U	**0.10**	J	0.10	UJ	0.10	UJ	0.10	U	**0.10**	J	0.10	U	0.10	U
Nickel	28.3	U	28.3	U	**73.0**	J	23.8	UJ	23.8	UJ	28.3	U	28.3	UJ	28.3		28.3	U
Potassium	**3630**	J	**3630**	J	**1610**	J	**1330**	J	**6640**	J	**3580**	J	**25200**	J	**11500**	J	**11200**	J
Selenium	**3.0**	R	**3.0**	R	6.0	UJ	6.0	UJ	6.0	UJ	**3.0**	R	**6.0**	R	**6.0**	J	**6.0**	J
Silver	5.3	U	5.3	U	**6.1**	J	5.3	UJ	5.3	UJ	5.3	U	5.3	UJ	5.3	U	5.3	U
Sodium	**35800**		**33100**		**48000**	J	**13300**	J	**47100**	J	**12100**		**179000**	J	**69100**		**68200**	
Zinc	3.2	U	3.2	U	3.2	UJ	3.2	UJ	**3.2**	J	3.7	UB	3.2	UJ	4.9	U	4.9	U
Cyanide	**17.9**	J	**14.4**	J	**8.5**	J	**7.3**	J	**7.8**	J	12.4	UB	**31.9**		**12**	J	**15.2**	
VOLATILE ORGANICS																		
1,1-Dichloroethane	10	U	10	U	10	U	10	U	**4**	J	10	U	**5**	J	10	U	10	U
SEMIVOLATILE ORGANICS																		
Diethylphthalate	**19**	J	**9**	J	10	U	10	U	**2**	J	10	UJ	10	U	10	U	10	U
bis(2-Ethylhexyl)phthalate	10	UJ	10	U	**3**	J	10	U	10	U	10	UJ	**2**	J	10	U	10	U

U: Analyte not detected
J: Estimated Value
R: Rejected Value (The data value is unusable.)

Table 3-4
Residential Well Ground Water Analytical Detections Summary - March 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	RW-21		RW-21 Dup		RW-19		RW-16		RW-13		RW-15		RW-14	
Sample number	S12		R12		S09		S04		S05		S03		S10	
Date sampled	3/16/2000		3/16/2000		3/15/2000		3/15/2000		3/15/2000		3/15/2000		3/15/2000	
Units	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS														
Arsenic	7		8	J	2	U	2	U	4	U	5	J	2	U
Barium	63.8		64.5		72.8		50.4		32.8		128		43.5	
Calcium	93300	JB	92300	JB	105000	JB	101000	JB	91800	JB	91500	JB	115000	JB
Chromium	3.4	UJ	3.4	UJ	3.4	UJ	3.4	UJ	3.4	UJ	3.4	UJ	3.4	UJ
Cobalt	10.5	J	10.1	UJ	10.1	UJ	10.1	UJ	10.1	UJ	10.1	UJ	14	J
Copper	7.3	J	4	U	26.1	J	7.3	J	14.2	J	7.3	J	66.1	J
Iron	5050		5030		22.4	U	104	BJ	22.4	U	1670		25.3	JB
Magnesium	21500		22000		20200		21700		19800		26500		20800	
Manganese	63.1		59.6		355		359		3.2	U	213		3.2	U
Nickel	19.4	U	19.4	U	19.4	U	19.4	U	21.4	J	19.4	U	19.4	U
Potassium	1150		1160		2580		1790		4650		1330		4300	
Sodium	14900		14700		65400		22600	J	126000		14500		82500	
Zinc	18.9	J	14.2	J	31.5	J	17.4	J	95.6	J	44.3	J	160	J
MISC. INORGANICS														
Bromide (µg Br/L)	NS		NS		60	J	50	J	NS		60	J	NS	
Sulfate (mg SO_4/L)	NS		NS		133		138		NS		154		NS	
VOLATILE ORGANICS														
Sample number	EDCJ5		EDCJ9		EDCK3		EDCK0		EDCK6		EDCK1		EDCJ8	
Vinyl Chloride	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1-Dichloroethane	7		7		1	U	0.6	J	1	U	1	U	1	U
cis-1,2-Dichloroethene	0.5	J	0.5	J	1	U	1	U	1	U	1	U	1	U
Chloroform	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichloroethane	0.7	J	1	U	1	U	1	U	1	U	0.6	J	1	U
1,2-Dichloropropane	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Benzene	0.4	J	0.4	J	1	U	1	U	1	U	1	U	1	U
SEMIVOLATILE ORGANICS														
Sample number	EDCJ5		EDCJ9		EDCK3		EDCK0		EDCK6		EDCK1		EDCJ8	
No Semivolatile Compounds Detected	5	U	5	U	5	U	5	U	5	U	5	U	5	U

U: Analyte Not detected
J: Estimated value
B: Analyte also present in blank
NS: Not Sampled

Table 3-4
Residential Well Ground Water Analytical Detections Summary - March 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	RW-12		RW-22		RW-20		RW-17		RW-18	
Sample number	S13		S11		S08		S06		S07	
Date sampled	3/16/2000		3/16/2000		3/15/2000		3/15/2000		3/15/2000	
Units	µg/L		µg/L		µg/L		µg/L		µg/L	
	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS										
Arsenic	2	J	4	U	2	U	6	J	7	
Barium	108		60.4		28.1		113		102	
Calcium	100000	JB	177000	JB	103000	JB	113000	JB	122000	JB
Chromium	3.6	JB	3.4	UJ	3.4	UJ	3.4	UJ	3.5	J
Cobalt	10.1	UJ	10.1	UJ	10.1	UJ	10.1	UJ	10.1	UJ
Copper	5.8	JB	4	U	9	J	11.9	J	4.1	J
Iron	885		2170		51.1	JB	5860		6120	
Magnesium	21500		18200	J	19000	J	16100	J	16000	J
Manganese	284		1560		146		73		72.3	
Nickel	19.4	U	19.4	U	19.4	U	19.4	U	19.4	U
Potassium	1790		5270		3660		2610		2870	
Sodium	17600		44400		56700	J	13500	J	33200	
Zinc	10.3	U	17.4	J	20.5	J	19	J	30.1	J
MISC. INORGANICS										
Bromide (µg Br⁻/L)	NS		70	J	60	J	NS		60	J
Sulfate (mg SO_4/L)	NS		171		132		NS		146	
VOLATILE ORGANICS										
Sample number	EDCJ4		EDCK8		EDCK4		EDCK5		EDCK2	
Vinyl Chloride	1	U	0.9	J	1	U	1	U	0.7	J
1,1-Dichloroethane	1	U	3		0.5	J	2		2	
cis-1,2-Dichloroethene	1	U	2		0.6	J	0.8	J	1	
Chloroform	1	U	1	U	0.4	J	1	U	1	U
1,2-Dichloroethane	1	U	0.6	J	1	U	1	U	1	U
1,2-Dichloropropane	1	U	10		1	U	1	U	1	U
Benzene	1	U	0.4	J	1	U	1	U	1	U
SEMIVOLATILE ORGANICS										
Sample number	EDCJ4		EDCK8		EDCK4		EDCK5		EDCK2	
No Semivolatile Compounds Detected	5	U	5	U	5	U	5	U	5	U

U: Analyte Not detected
J: Estimated value
B: Analyte also present in blank
NS: Not Sampled

Table 3-5
Residential Well Ground Water Analytical Detections Summary - April 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	RW-21		RW-19		RW-16		RW-13		RW-15	
Sample number	SO1		SO2		SO3		SO6		SO4	
Date sampled	4/17/2000		4/17/2000		4/17/2000		4/17/2000		4/17/2000	
Units	µg/L		µg/L		µg/L		µg/L		µg/L	
	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS										
Arsenic	7		2	U	2	U	2	J	5	J
Barium	66.6		70.4		57.6		29.1		131	
Calcium	88100		102000		110000		83000		90000	
Chromium	6.7	U	6.7	U	6.7	U	6.7	U	2	J
Copper	31.3	J	11.4	J	14.7	J	13.3	J	34.8	J
Iron	5760	J	19.6	JB	86	JB	45.3	JB	1710	J
Lead	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U
Magnesium	20600		20000		24000		19400		27600	
Manganese	58.7		325		380		0.6	J	223	
Nickel	21	U	21	U	21	U	21	U	21	U
Potassium	1100		2430		1880		4000		1280	
Sodium	15400	J	63200	J	30300	J	116000	J	15200	J
Zinc	34	JB	20.5	JB	13.1	JB	128	B	28.3	JB
MISC. INORGANICS										
Bromide (µg Br^-/L)	60	J	60	J	60	J	60	J	60	J
Sulfate (mg SO_4/L)	142		130		130		127		153	
VOLATILE ORGANICS										
Sample number	EDPK9		EDPL0		EDPL1		EDPL4		EDPL2	
Methylene Chloride	6		2	U	2	U	2	U	2	U
1,1-Dichloroethane	12		1	U	0.8	J	1	U	1	U
cis-1,2-Dichloroethene	0.8	J	1	U	1	U	1	U	1	U
1,2-Dichloropropane	1	U	1	U	1	U	1	U	1	U

U: Analyte Not detected
J: Estimated value
B: Analyte also present in blank

Table 3-5
Residential Well Ground Water Analytical Detections Summary - April 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	RW-14		RW-12		RW-22		RW-22 Dup		RW-20	
Sample number	SO5		SO7		SO10		SO11		SO8	
Date sampled	4/17/2000		4/18/2000		4/18/2000		4/18/2000		4/18/2000	
Units	µg/L		µg/L		µg/L		µg/L		µg/L	
	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS										
Arsenic	2	U	3	J	2	U	2	U	2	U
Barium	43.9		109		76.6		63.2		39.3	
Calcium	106000		99000		205000		173000		132000	
Chromium	6.7	U	6.7	U	6.7	U	6.7	U	2.1	J
Copper	7.9	J	9.3	UJ	15.2	J	10.7	J	13.3	J
Iron	27.8	JB	1130	J	2790	J	2270	J	100	JB
Lead	2.0	U	2.0	U	2.0	J	2.0	U	2.0	U
Magnesium	21600		21500		21700		18200		24900	
Manganese	1.9	U	299		1880		1560		202	
Nickel	21	U	9.8	J	21	U	21	U	21	U
Potassium	3850		1760		6920		5170		4140	
Sodium	84700	J	19000	J	92200	J	73400	J	81000	J
Zinc	173	B	12.5	JB	39.1	B	26.9	JB	26.5	JB
MISC. INORGANICS										
Bromide (µg Br/L)	60	J	70	J	70	J	70	J	60	J
Sulfate (mg SO_4/L)	134		132	U	152		152		109	
VOLATILE ORGANICS										
Sample number	EDPL3		EDPL5		EDPL8		EDPM0		EDPL6	
Methylene Chloride	2	U	2	U	2	U	2	U	2	U
1,1-Dichloroethane	1	U	1	U	3		4		0.8	J
cis-1,2-Dichloroethene	1	U	1	U	2		2		0.7	J
1,2-Dichloropropane	1	U	1	U	8		9		1	U

U: Analyte Not detected
J: Estimated value
B: Analyte also present in blank

Table 3-5
Residential Well Ground Water Analytical Detections Summary - April 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	RW-23		RW-17		RW-18	
Sample number	SO9		SO12		SO13	
Date sampled	4/18/2000		4/19/2000		4/19/2000	
Units	µg/L		µg/L		µg/L	
	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS						
Arsenic	2	U	7	J	8	
Barium	35.8		106		92.3	
Calcium	99800		112000		97500	
Chromium	6.7	U	6.7	U	6.7	U
Copper	10.7	J	9.3	UJ	62.1	J
Iron	46.5	UJ	5870	J	5530	J
Lead	2.0	U	2.0	U	2.0	U
Magnesium	21500		15700		13600	
Manganese	30		72		65.2	
Nickel	21	U	21	U	21	U
Potassium	3700		2340		2590	
Sodium	91800	J	14800	J	35100	J
Zinc	87.3	B	12	JB	31.1	JB
MISC INORGANICS						
Bromide (µg Br^-/L)	60	J	60	J	60	J
Sulfate (mg SO_4/L)	105		148		142	
VOLATILE ORGANICS						
Sample number	EDPL7		EDPM1		EDPM2	
Methylene Chloride	2	U	UJ	U	2	U
1,1-Dichloroethane	1	U	3		2	
cis-1,2-Dichloroethene	1	U	1		1	
1,2-Dichloropropane	1	U	1	U	1	U

U: Analyte Not detected
J: Estimated value
B: Analyte also present in blank

Table 3-6
Residential and Monitoring Well Ground Water Analytical Detections Summary - November 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	RW-24		RW-22		RW-22 Dup		WT116A		WT101A	
Sample number	S01		S02		D02		S03		S04	
Date sampled	11/15-16/2000		11/15-16/2000		11/15-16/2000		11/15-16/2000		11/15-16/2000	
Units	µg/L		µg/L		µg/L		µg/L		µg/L	
	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS										
Aluminum	35.9	J	58.2		53.7		335		112	
Arsenic	2	U	4	U	2	U	10	U	6.4	
Barium	48.1		46.9		47.4		133		79.3	
Calcium	102000	B	129000	B	129000	B	745000	B	227000	B
Cobalt	1	U	0.8	J	0.9	JB	1.1		1	U
Copper	2.3	UB	1	UB	1.4	UB	2.1	UB	2	U
Iron	60.2	B	1840	B	1720	B	8200	B	9490	B
Lead	2	U	2	U	2	U	2	J	2	U
Magnesium	24800		14200		14200		60000		20200	
Manganese	103		1250		1250		1240		929	
Nickel	2.9	UB	3.4	UB	3.6	UB	4.2	UB	2.3	UB
Potassium	2790		4400		4670		30800		10100	
Sodium	53100	JB	42300		42700	JB	214000		36700	
Zinc	21.7	J	14.3	J	20.3	JB	85.5	J	14.9	JB
MISC. INORGANICS										
Bromide (µg Br^-/L)	40	BJ	14	U	30	BJ	3750	BJ	320	BJ
Sulfate (mg SO_4^-/L)	79.3	UB	105	UB	104	UB	1020	B	177	UB
Chloride (mg Cl^-/L)	96.5	UB	99.9	UB	98.4	UB	26	UB	27.2	UB
VOLATILE ORGANICS										
Ethyl ether	1	U	26		31		100		49	
Dichlorofluoromethane	1	U	5		6		10		6	
1,1-Dichloroethane	1	U	4		4		9		14	
cis-1,2-Dichloroethene	1	U	2		3		1	U	1	U
1,2-Dichloroethane	1	U	1	UB	1	UB	1	U	1	U
Benzene	1	U	1	U	1	U	8		2	
1,2-Dichloropropane	1	U	8		8		2		1	U
SEMIVOLATILE ORGANICS										
Di-n-butylphthalate	4	JB	5	U	14	B	4	JB	4	JB
bis(2-Ethylhexyl)phthalate	5	U	3	J	3	JB	5	U	5	U
2-Hydroxybenzothiazole	10	UJ	10	UJ	10	UJ	23	J	30	UJ

U: Not detected
J: Estimated value.
B: Analyte also present in blank

Table 3-7
Monitoring Well Ground Water Analytical Detections Summary - April/May 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	WTB1		WTB3		WTB4		WTE1		WTE3		WTG1		WTG3		WT101A		WT101A Dup		WT101B		WT101C		WT102A	
Sample number	S030		S031		S032		S045		S046		S037		S036		S050		S051		S052		S049		S020	
Date sampled	4/26/2000		4/26/2000		4/26/2000		5/2/2000		5/2/2000		4/27/2000		4/27/2000		5/3/2000		5/3/2000		5/3/2000		5/3/2000		4/25/2000	
Screened interval (Feet BGS)	468.9-474.9		127.2-137.2		169.2-174.2		73.9-83.9		173.9-178.9		38.0-43.0		162-172		8.5-18.5		8.5-18.5		95.5-100.5		162.5-167.5		8.4-18.4	
Units	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS																								
Aluminum	118	U	118	U	118	U	118	U	118	U	118	U	36.7	J	118	U	118	U	118	U	152		118	U
Arsenic	2	U	5	J	2	U	7	U	5	J	2	U	10		5	J	14	U	7	U	10		2	U
Barium	122		60.2		37		43.5		51.3		79.1		79.4		83.1		82.4		72.3		77.6		46.7	
Cadmium	0.1	U	0.1	U	0.1	U	0.3	U	0.3	U	0.1	U	0.1	U	0.3	U	0.3	U	0.3	U	0.3	U	0.1	U
Calcium	52500		96800		69400		174000		58300		94300		76400		258000		242000		137000		47900		173000	
Chromium	2.4	J	6.7	U	6.7	U	6.7	U	6.7	U	6.7	U	6.7	U	6.7	U	6.7	U	6.7	U	7.7	J	17.8	J
Cobalt	13.2	U	13.2	U	13.2	U	13.2	U	13.2	U	13.2	U	13.2	U	13.2	U	4	J	13.2	U	4	J	4.1	J
Copper	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U	9.3	U
Iron	527	JB	426	JB	415	JB	5150		2240		1010	JB	1150	JB	16300		16100		2850		1380		115	JB
Lead	2	U	2	U	2	U	3	J	3	J	2	U	2	U	7	U	7	U	7	U	7	U	2	U
Magnesium	20900		27900	J	21200	J	35500		23800		24300	J	23500	J	27300		27500		52800		20100		18800	J
Manganese	40.1		356		206		204	J	21.1	J	52.7		21.8		1610	J	1540	J	36	J	20.5	J	86.7	
Mercury	0.1	U	0.1	U	0.1	U	0.1	UJ	0.1	UJ	0.1	U	0.1	U	0.1	UJ	0.1	UJ	0.1	UJ	0.1	UJ	0.1	U
Nickel	8.3	J	21	UJ	21	UJ	21	U	21	U	7	J	8.1	J	21	U	21	U	21	U	7	J	45.4	J
Potassium	2100		1290		759		4120		1810		1430		1260		6730		6810		6280		4130		2060	
Selenium	2	U	2	U	2	U	14	U	7	U	2	U	4	J	7	U	7	U	7	U	7	U	2	U
Silver	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U
Sodium	55100		20300		4600		19100		12400		13800		18400		66800		65200		43100		36100		100000	
Vanadium	5.1	U	5.1	U	5.1	U	5.1	U	5.1	U	5.1	U	5.1	U	5.1	U	5.1	U	5.1	U	5.1	U	5.1	U
Zinc	36.9	JB	34.1	U	34.1	U	34.1	U	34.1	U	34.1	U	34.1	U	34.1	U	34.1	U	34.1	U	34.1	U	34.1	U
MISC. INORGANICS																								
Bromide (µg Br^-/L)	180	J	80	J	110	J	120	J	130	J	50	J	60	J	520	J	530	J	340	J	880	J	60	J
Sulfate (mg SO_4/L)	60	J	132	J	38	J	347		57		59	J	32	J	218		215		211		0.42	J	202	J

NS: Not sampled
U: Not detected
J: Estimated value
B: Analyte also present in blank

Table 3-7
Monitoring Well Ground Water Analytical Detections Summary - April/May 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	WTB1		WTB3		WTB4		WTE1		WTE3		WTG1		WTG3		WT101A		WT101A Dup		WT101B		WT101C		WT102A	
Sample number	S030		S031		S032		S045		S046		S037		S036		S050		S051		S052		S049		S020	
Date sampled	4/26/2000		4/26/2000		4/26/2000		5/2/2000		5/2/2000		4/27/2000		4/27/2000		5/3/2000		5/3/2000		5/3/2000		5/3/2000		4/25/2000	
Screened interval (Feet BGS)	468.9-474.9		127.2-137.2		169.2-174.2		73.9-83.9		173.9-178.9		38.0-43.0		162-172		8.5-18.5		8.5-18.5		95.5-100.5		162.5-167.5		8.4-18.4	
Units	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
VOLATILE ORGANICS																								
Sample number	EDCG3		EDCG4		EDCG5		EOOFH		EOOFJ		EOOF8		EDCG9		ECFN2		ECFN3		ECFN4		EOOF5		EDPN4	
Vinyl Chloride	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chloroethane	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	2		2		1	U	1	U
1,1-Dichloroethane	1	U	1	U	1	U	1	U	1	U	1	U	1	U	8		8		1	U	1	U	1	U
cis-1,2-Dichloroethene	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Chloroform	1	U	1	U	1	U	1	U	3		1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichloropropane	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Trichloroethene	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Benzene	1	U	1	U	1	U	1	U	1	U	1	U	1	U	2		2		1	U	1	U	1	U
Bromoform	1	U	1	U	1	U	1	U	1		1	U	1	U	1	U	1	U	1	U	1	U	1	U
Tetrachloroethene	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
SEMIVOLATILE ORGANICS																								
Sample number	EDCG3		EDCG4		EDCG5		EOOFH		EOOFJ		EOOF8		EDCG9		ECFN2		ECFN3		ECFN4		EOOF5		EDPN4	
Diethylphthalate	5	U	5	U	5	U	3	J	2	J	5	U	5	U	3	J	4	J	2	J	5	U	5	U
Butylbenzylphthalate	5	U	5	U	5	U	4	J	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
bis(2-Ethylhexyl)phthalate	5	U	6		5	U	19		35		4	J	19		8		4	J	2	J	2	J	5	U
Di-n-octylphthalate	5	U	5	U	5	U	4	J	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U

NS: Not sampled
U: Not detected
J: Estimated value
B: Analyte also present in blank

Table 3-7
Monitoring Well Ground Water Analytical Detections Summary - April/May 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	WT102B		WT102C		WT105A		WT106A		WT111A		WT112A		WT112B		WT112B Dup		WT113A		WT113B		WT114A		WT114A - Split	
Sample number	S019		S018		S047		S048		S040		S035		S033		S034		S029		S028		S056		S056	
Date sampled	4/25/2000		4/25/2000		5/2/2000		5/2/2000		4/28/2000		4/27/2000		4/27/2000		4/27/2000		4/26/2000		4/26/2000		5/3/2000		5/3/2000	
Screened interval (Feet BGS)	62.9-67.9		157-162		8.5-18.5		8.6-18.6		11.9-21.9		7.7-17.7		57.1-62.1		57.1-62.1		14.4-24.4		65.0-70.0		14.5-24.5		14.5-24.5	
Units	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS																								
Aluminum	118	U	500		112	J	3090		463		118	U	118	U	118	U	118	U	118	U	118	U	44	J
Arsenic	6	J	3	J	7	U	46		7	U	2	U	5	J	4	J	2	U	3	J	9		10	J
Barium	103		104		8.1		160		256		28.6		86.7		86		13.8		68.4		101	B	115	
Cadmium	0.1	U	0.1	U	0.3	U	0.1	J	0.2	J	0.1	U	0.1	U	0.1	U	0.1	J	0.1	U	0.3	U	2.5	U
Calcium	75800		129000	B	57400		175000		113000		247000		81800		79900		64300		101000		192000	B	203000	
Chromium	24.2	J	26.8	J	23.9	J	21.6	J	2.3	J	6.7	U	6.7	U	6.7	U	6.7	U	6.7	U	6.7	U	10	U
Cobalt	13.2	U	13.2	U	4.1	J	13.2	U	12.2	J	13.2	U	13.2	U	13.2	U	13.2	U	13.2	U	5.9	J	5.8	J
Copper	9.3	U	4	UB	9.3	U	11		9.3	U	9.3	U	9.3	U	9.3	U	4.2	JB	9.3	U	9.3	U	10	U
Iron	1580	JB	2210	JB	407		27600		12600		23.3	JB	1180	JB	1220	JB	59.8	JB	1210	JB	6510	B	6290	
Lead	2	U	2	J	7	U	6	J	7	U	2	U	2	U	2	U	2	U	2	U	7	U	10	U
Magnesium	22300		45600	B	16500	J	26800		19100	J	17000	J	21000	J	20900	J	16500	J	21400		18600	BJ	21000	
Manganese	91.9		288	B	160	J	559	J	1440	J	0.7	J	93.1		94.5		3.1		97.6		276	BJ	288	
Mercury	0.1	U	0.1	U	0.1	UJ	0.1	UJ	0.1	UJ	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	UJ	0.011	J
Nickel	8.1	J	23.7	J	73.3		11.7	J	8.7	J	21	UJ	21	UJ	21	UJ	21	UJ	21	UJ	21	U	4.8	J
Potassium	1840		1970		1360		4200		8380		1700		1320		1380		1210		2040		3390	B	3750	
Selenium	2	U	2	U	7	U	7	U	7	U	2	U	2	U	2	U	2	U	2	U	21	U	20	U
Silver	3.4	J	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	5	U
Sodium	25900		6060	UB	7720		29300		39400		13800		22800		23300		14200		15300		123000	B	125000	
Vanadium	1.9	J	3.2	J	5.1	U	5.1	U	5.1	U	2.3	J	5.1	U	5.1	U	5.1	U	5.1	U	5.1	U	20	U
Zinc	34.1	U	13.5	JB	34.1	U	31.7	JB	18	JB	34.1	U	34.1	U	34.1	U	34.1	U	34.1	U	34.1	U	10	U
MISC. INORGANICS																								
Bromide (µg Br^-/L)	80	J	140	J	110	J	420	J	430	J	40	J	70	J	70	J	14	U	60	J	170	J	NS	
Sulfate (mg SO_4/L)	58	J	36	J	36		146		264		434	J	56	J	56	J	24	J	131	J	177		NS	

NS: Not sampled
U: Not detected
J: Estimated value
B: Analyte also present in blank

Table 3-7
Monitoring Well Ground Water Analytical Detections Summary - April/May 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	WT102B		WT102C		WT105A		WT106A		WT111A		WT112A		WT112B		WT112B Dup		WT113A		WT113B		WT114A		WT114A - Split	
Sample number	S019		S018		S047		S048		S040		S035		S033		S034		S029		S028		S056		S056	
Date sampled	4/25/2000		4/25/2000		5/2/2000		5/2/2000		4/28/2000		4/27/2000		4/27/2000		4/27/2000		4/26/2000		4/26/2000		5/3/2000		5/3/2000	
Screened interval (Feet BGS)	62.9-67.9		157-162		8.5-18.5		8.6-18.6		11.9-21.9		7.7-17.7		57.1-62.1		57.1-62.1		14.4-24.4		65.0-70.0		14.5-24.5		14.5-24.5	
Units	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
VOLATILE ORGANICS																								
Sample number	EDPN2		EDPN1		EOOFK		EOOF4		EOOFB		EDCG8		EDCG6		EDCG7		EDCG2		EDCG0		E01TP		EECFN10	
Vinyl Chloride	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	2	U
Chloroethane	1	U	1	U	1	U	0.6	J	1	U	1	U	1	U	1	U	1	U	1	U	1	U	2	U
1,1-Dichloroethane	1	U	1	U	1	U	0.9	J	1		1	U	1	U	1	U	1	U	1	U	3		2.6	
cis-1,2-Dichloroethene	1	U	1	U	1	U	1		1	U	1	U	1	U	1	U	1	U	1	U	1	U	2	U
Chloroform	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	2	U
1,2-Dichloropropane	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	2	U
Trichloroethene	1	U	1	U	1	U	0.6	J	1	U	1	U	1	U	1	U	1	U	1	U	1	U	2	U
Benzene	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	0.9	J
Bromoform	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	2	U
Tetrachloroethene	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	2	U
SEMIVOLATILE ORGANICS																								
Sample number	EDPN2		EDPN1		EOOFK		EOOF4		EOOFB		EDCG8		EDCG6		EDCG7		EDCG2		EDCG0		E01TP		EECFN10	
Diethylphthalate	5	U	5	U	3	J	3	J	5	U	5	U	5	U	5	U	5	U	5	U	1	J	NS	
Butylbenzylphthalate	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	NS	
bis(2-Ethylhexyl)phthalate	5	U	2	J	17		47		5	U	39		5	U	5	U	5	U	5	U	2	J	NS	
Di-n-octylphthalate	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	NS	

NS: Not sampled
U: Not detected
J: Estimated value
B: Analyte also present in blank

Table 3-7
Monitoring Well Ground Water Analytical Detections Summary - April/May 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	WT114B		WT115A		WT116A		WT116A Dup		WT116B		WT117A		WT117B		WT118B		WT119A	
Sample number	S057		S043		S053		S054		S055		S038		S039		S041		S042	
Date sampled	5/3/2000		5/1/2000		5/3/2000		5/3/2000		5/3/2000		4/27/2000		4/27/2000		4/28/2000		4/28/2000	
Screened interval (Feet BGS)	62.8-67.8		9.7-19.7		4.8-14.8		4.8-14.8		55.4-60.4		7.9-17.9		58.5-63.5		59.9-64.9		7.5-17.5	
Units	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS																		
Aluminum	118	U	8860		118	U	118	U	118	U	827		118	U	118	U	38.3	J
Arsenic	9		7	U	7	U	7	U	7	U	2	U	2	U	7	U	6	J
Barium	69.4		105		79.9		79.6		135		41.3		35.9		93.4		94	
Cadmium	0.3	U	0.1	J	0.1	J	0.1	J	0.3	U	0.1	U	0.1	U	0.3	U	0.3	U
Calcium	108000		241000		666000		685000		203000		70900		179000		193000		215000	
Chromium	3	J	12.8	J	6.7	U	6.7	U	6.7	U	9.3	J	6.7	U	6.7	U	2	J
Cobalt	13.2	U	13.2	U	11.2	J	11.5	J	13.2	U	13.2	U	13.2	U	13.2	U	13.2	U
Copper	9.3	U	19.7		15.8		15.5		9.3	U	3.2	JB	9.3	U	9.3	U	9.3	U
Iron	6320		6500		31900		32400		3710		508	JB	2280	JB	5790		2650	
Lead	7	U	11		6	J	13	J	7	U	2	U	2	U	7	U	7	U
Magnesium	17500	J	12400	J	66900		66100		22900		12000	J	24200	J	20000		70800	
Manganese	92.5	J	380	J	1810	J	1800	J	206	J	206		71.7		126	J	318	J
Mercury	0.1	UJ	0.1	UJ	0.1	UJ	0.1	UJ	0.1	UJ	0.1	U	0.1	U	0.1	UJ	0.1	UJ
Nickel	21	U	11.5	J	13.3	J	12.2	J	21	U	7.5	J	21	UJ	21	U	21	U
Potassium	2700		4440		19600		18900		5780		2180		1790		7800		22200	
Selenium	7	U	7	U	14	U	14	UJ	14	U	4	U	4	U	14	U	14	U
Silver	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U	11.1	U
Sodium	14100		24600		161000		160000		23500		5110		17100		18700		61100	
Vanadium	5.1	U	14.5		5.1	U	5.1	U	5.1	U	3.1	J	5.1	U	5.1	U	5.1	U
Zinc	34.1	U	37.7	JB	178	J	194	J	34.1	U	34.1	U	34.1	U	34.1	U	34.1	U
MISC. INORGANICS																		
Bromide (µg Br^-/L)	70	J	620		2380		2420		320	J	60	J	70	J	200	J	460	J
Sulfate (mg SO_4/L)	156		254		1260		1250		143		169	J	318	J	351		420	

NS: Not sampled
U: Not detected
J: Estimated value
B: Analyte also present in blank

Table 3-7
Monitoring Well Ground Water Analytical Detections Summary - April/May 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	WT114B		WT115A		WT116A		WT116A Dup		WT116B		WT117A		WT117B		WT118B		WT119A	
Sample number	S057		S043		S053		S054		S055		S038		S039		S041		S042	
Date sampled	5/3/2000		5/1/2000		5/3/2000		5/3/2000		5/3/2000		4/27/2000		4/27/2000		4/28/2000		4/28/2000	
Screened interval (Feet BGS)	62.8-67.8		9.7-19.7		4.8-14.8		4.8-14.8		55.4-60.4		7.9-17.9		58.5-63.5		59.9-64.9		7.5-17.5	
Units	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
VOLATILE ORGANICS																		
Sample number	E01TQ		EOOFF		ECFN5		ECFN6		ECFN8		EOOF9		EOOFA		EOOFC		EOOFE	
Vinyl Chloride	1	U	1	U	1		1		1	U	1	U	1	U	1	U	1	U
Chloroethane	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,1-Dichloroethane	1	U	1	U	8		7		1	U	1	U	1	U	2		3	
cis-1,2-Dichloroethene	1	U	0.5	J	1		1		1	U	1	U	1	U	1	U	1	U
Chloroform	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
1,2-Dichloropropane	1	U	1	U	1		1		1	U	1	U	1	U	1	U	1	U
Trichloroethene	1	U	0.6	J	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Benzene	1	U	1		1	U	1	U	1	U	1	U	1	U	1	U	1	U
Bromoform	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U
Tetrachloroethene	1	U	0.8	J	1	U	1	U	1	U	1	U	1	U	1	U	1	U
SEMIVOLATILE ORGANICS																		
Sample number	E01TQ		EOOFF		ECFN5		ECFN6		ECFN8		EOOF9		EOOFA		EOOFC		EOOFE	
Diethylphthalate	5	U	2	J	5	U	4	J	2	J	5	U	5	U	5	U	5	U
Butylbenzylphthalate	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U
bis(2-Ethylhexyl)phthalate	1	J	18		7		2	J	2	J	7		5	U	5	U	5	U
Di-n-octylphthalate	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U	5	U

NS: Not sampled
U: Not detected
J: Estimated value
B: Analyte also present in blank

Table 3-8
Direct-Push Ground Water Analytical Detections Summary - April/May 2000
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	GPE-1		GPE-2		GPE-3		GP114-1		GP114-2		GP114-3		GP16-1		GP16-2		GP101-1		GP101-2	
Sample number	SO14		SO15		SO16		SO21		SO22		SO23		SO24		SO25		SO26		SO27	
Date sampled	4/25/2000		4/25/2000		4/25/2000		4/25/2000		4/25/2000		4/25/2000		4/25/2000		4/25/2000		4/25/2000		4/25/2000	
Depth (Feet BGS)	30-32		35-37		41-43		14.5-16.5		35-37		55-57		37-39		55-57		35-37		58-60	
Units	µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
	Result	Qual	Result	Qual	Result	Qua	Result	Qual	Result	Qual	Result	Qua	Result	Qual	Result	Qual	Result	Qual	Result	Qual
TOTAL METALS																				
Aluminum	2640		3960		3190		118	U	1180		6420		2160		11900		3410		455	
Arsenic	5	J	13		5	J	2	U	39		38		7	J	74		17		3	J
Barium	99		170		120		80.6		48.4		95.6		45.7		164		118		128	
Beryllium	2	U	2	U	2	U	2	U	2	U	2	U	2	U	0.7	JB	2	U	2	U
Cadmium	0.1	J	0.2	J	0.1	J	0.1	U	0.1	U	0.3	J	0.1	J	0.6	J	0.2	J	0.1	U
Calcium	351000		471000		211000		179000		245000		315000		176000		505000		281000		210000	
Chromium	46.5	J	154	J	90.3	J	6.7	U	19.1	J	173	J	38.1	J	124	J	64.4	J	12.6	J
Cobalt	5.3	J	9.3	J	8.2	J	13.2	U	13.2	U	14.9	J	7.7	J	20.8	J	10.2	J	13.2	U
Copper	23.5	B	55.1		27.9	B	9.3	U	11.5	B	76.3	U	18.4	B	105	U	31.1	B	7.3	JB
Iron	19100	JB	38400	JB	17800	JB	337	JB	13400	JB	56300	JB	12800	JB	71400	JB	26400	JB	12000	JB
Lead	15		27		12		2	U	9		35		10		47		27		4	J
Magnesium	47000		58800		31100		23200		34500		57300		34100		116000		42600		33800	
Manganese	751		957		490		500		309		881		563		1820	J	634		356	
Mercury	0.1	U	0.2	J	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	J	0.1	U	0.1	U
Nickel	26.2	J	38.2	J	22.4	J	21	U	7	J	57.8	J	18.4	J	64.6	J	29.9	J	10.2	J
Potassium	8490		12500		9000		3020		2760		4650		3060		4330		6080		6190	
Sodium	62200		86300		31500		178000		15300		17300		21600		16300		22800		25200	
Vanadium	8.2		7.3		2.5	J	5.1	U	5.1	U	8.8		3.9	J	29.9		6		5.1	U
Zinc	94.1	JB	149	JB	86.1	JB	34.1	U	40.7	JB	156	J	43	JB	172	J	82.3	JB	34.3	JB
MISC. INORGANICS																				
Bromide (µg Br⁻/L)	860	J	1330	J	260	J	170	J	60	J	70	J	40	J	60	J	290	J	170	J
Sulfate (mg SO_4/L)	389	J	654	J	288	J	167	J	178	J	162	J	72	J	134	J	76	J	97	J
VOLATILE ORGANICS																				
Sample number	EDPM3		EDPM6		EDPM7		EDPN5		EDPN6		EDPN7		EDCF6		EDCF7		EDCF8		EDCF9	
Chloroethane	2		1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	2	
Carbon Disulfide	1	U	0.5	J	0.6	J	1	U	1	U	0.5	J	1	U	1	U	0.6	J	1	U
1,1-Dichloroethane	0.8	J	1	U	1	U	1		4		1		1	U	1		5		0.8	J
cis-1,2-Dichloroethene	1	U	1	U	1	U	1	U	1		0.7	J	1	U	1	U	1	U	1	U
1,2-Dichloropropane	0.5	J	1	U	1	U	1	U	2		1	U	2		1	U	1	U	1	U
Trichloroethene	1	U	1	U	1	U	1	U	1	U	1	U	0.5	J	1	U	1	U	1	U
Benzene	1		2		1	U	1	U	1		0.9	J	1	U	1	U	1		1	U
SEMIVOLATILE ORGANICS																				
Sample number	EDPM3		EDPM6		EDPM7		EDPN5		EDPN6		EDPN7		EDCF6		EDCF7		EDCF8		EDCF9	
Phenol	5	U	5	U	5		5	U	5	U	5	U	5	U	5	U	5	U	5	U
bis(2-Ethylhexyl)phthalate	5		5	U	4	J	5	U	5	U	2	J	5	U	5	U	5	U	4	J

U: Not detected
J: Estimated value
B: Analyte also present in blank

Table 3-9
Residential and Monitoring Well Ground Water Analytical Detections Summary - November 2000
Emerging Contaminants
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Lab ID	3210030		3210031		3220190	
Sample Location	RW-22		RW-22 Dup		WT116A	
Date	11/15/200		11/15/2000		11/16/2000	
Units	µg/L		µg/L		µg/L	
phenol	0.450	U	0.314	E	0.450	U
tri(2-chloroethyl)phosphate	0.649		0.741		0.040	U
triclosan	0.040	E	0.041	E	0.051	
bis(2-ethylhexyl) phthalate	3.620	E	2.500	U	2.500	U

U - Analyte not detected
E- Value exceeded the calibration range

Table 5-1
Soil Gas Analytical Detections Summary - November 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-11		TT-12		TT-13		TT-14			TT-14 Duplicate		TT-15	
Units	µg/m³		µg/m³		µg/m³		µg/m³			µg/m³		µg/m³	
	Result	RL	Result	RL	Result	RL	Result	RL	Qual	Result	RL	Result	RL
Analyte													
Vinyl Chloride	<	0.26	<	0.24	<	33	77		J	100		<	0.47
Bromomethane	<	0.52	<	0.48	<	66	1.0			<	64	<	0.94
Chloroethane	<	0.26	<	0.24	200		36			<	32	<	0.47
1,1-Dichloroethene	<	0.26	<	0.24	<	33	6.8			<	32	<	0.47
Carbon Disulfide	1.2		<	0.24	<	33	86		J	130		<	2.8
Acetone	<	2.6	<	2.4	<	330	<	2.30		<	320	<	4.70
Methylene Chloride	<	0.26	<	0.24	<	33	6.8		J	<	32	<	0.47
trans-1,2-Dichloroethene	<	0.26	<	0.24	<	33	12			<	32	<	0.47
1,1-Dichloroethane	<	0.26	<	0.24	470		500		J	2400		<	0.47
2-Butanone	<	2.6	<	2.4	<	330	<	2.30		<	320	<	4.70
Chloroform	<	0.26	<	0.24	<	33	<	0.23		<	32	<	0.47
1,1,1-Trichloroethane	<	0.26	<	0.24	<	33	250		J	300		<	0.47
Carbon Tetrachloride	<	0.26	<	0.24	<	33	40			<	32	<	0.47
Benzene	1.8		1.4		470		180		J	200		<	2.07
1,2-Dichloroethane	<	0.26	<	0.24	<	33	<	0.23		<	32	<	0.47
Trichloroethene	<	0.26	<	0.24	<	33	270		J	270		<	0.47
1,2-Dichloropropane	<	0.26	<	0.24	<	33	25			<	32	<	0.47
trans-1,3-Dichloropropene	<	0.26	<	0.24	<	33	<	0.23		<	32	<	0.47
Toluene	<	0.26	<	0.24	230		95		J	91		0.89	
cis-1,3-Dichloropropene	<	0.26	<	0.24	<	33	<	0.23		<	32	<	0.47
Tetrachloroethene	<	0.26	<	0.24	<	33	230		J	260		<	0.47
2-Hexanone	<	0.26	<	0.24	<	33	<	0.23		<	32	<	0.47
Chlorobenzene	<	0.26	<	0.24	<	33	11			<	32	<	0.47
Ethyl Benzene	<	0.26	0.54		3100		420		J	340		1.1	
m,p-Xylene	<	0.26	1.3		7100		730		J	400		1.4	
o-Xylene	<	0.26	<	0.24	220		390		J	320		0.52	
Styrene	<	0.26	<	0.24	<	33	13			<	32	<	0.47
cis-1,2-Dichloroethene	<	0.26	<	0.24	<	33	290		J	250		<	0.47

J= Estimated Value
NR= Not measured
R= Rejected Value (The data is unusable.)

Table 5-1
Soil Gas Analytical Detections Summary - November 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-16			TT-17		TT-18		TT-19			TT-20		TT-21	
Units	ug/m3			ug/m3		ug/m3		ug/m3			ug/m3		ug/m3	
	Result	RL	Qual	Result	RL	Result	RL	Result	RL	Qual	Result	RL	Result	RL
Analyte														
Vinyl Chloride	61			20		180		18000		J	<	0.15	NR	
Bromomethane	<	1.8		<	16	<	60	<	160		<	0.3	NR	
Chloroethane	<	3.6		<	8.1	<	30	<	79		<	0.15	NR	
1,1-Dichloroethene	<	1.8		<	8.1	69		130			<	0.15	NR	
Carbon Disulfide	4.7			19		920		2800			<	0.15	NR	
Acetone	<	18		<	81	<	300	<	790		1.5		NR	
Methylene Chloride	<	1.8		<	8.1	<	30	790			0.57		NR	
trans-1,2-Dichloroethene	4.6			<	8.1	<	30	<	79		<	0.15	NR	
1,1-Dichloroethane	89			57		<	30	<	79		<	0.15	NR	
2-Butanone	<	18		<	81	<	300	<	790		<	1.5	NR	
Chloroform	<	1.8		<	8.1	<	30	<	79		<	0.15	NR	
1,1,1-Trichloroethane	<	1.8		40	8.1	<	30	<	79		<	0.15	NR	
Carbon Tetrachloride	<	1.8		<	8.1	<	30	<	79		<	0.15	NR	
Benzene	190			37	8.1	200	30	<	79		0.36	0.15	NR	
1,2-Dichloroethane	<	1.8		<	8.1	<	30	<	79		<	0.15	NR	
Trichloroethene	14			9.5	8.1	340	30	<	79		<	0.15	NR	
1,2-Dichloropropane	18			14		<	30	<	79		<	0.15	NR	
trans-1,3-Dichloropropene	<	1.8		<	8.1	<	30	<	79		<	0.15	NR	
Toluene	5.6			35		240		<	79		1.3		NR	
cis-1,3-Dichloropropene	<	1.8		<	8.1	<	30	<	79		<	0.15	NR	
Tetrachloroethene	<	1.8		NR		460		<	79		<	0.15	NR	
2-Hexanone	<	1.8		NR		<	30	<	79		<	0.15	NR	
Chlorobenzene	<	1.8		NR		51		<	79		<	0.15	NR	
Ethyl Benzene	<	1.8		NR		3200		150			0.16		NR	
m,p-Xylene	2.4		B	NR		1700		93			0.54		NR	
o-Xylene	<	1.8		NR		600		<	79		0.18		NR	
Styrene	<	1.8		NR		<	30	<	79		0.54		NR	
cis-1,2-Dichloroethene	17			<	8.1	65		560			<	0.15	NR	

J= Estimated Value
NR= Not measured
R= Rejected Value (The data is unusable.)

Table 5-1
Soil Gas Analytical Detections Summary - November 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-22			TT-23		TT-24		TT-25		TT-26			TT-26 (Duplicate)		TT-27	
Units	ug/m³			ug/m³		ug/m³		ug/m³		ug/m³			ug/m³		ug/m³	
Analyte	Result	RL	Qual	Result	RL	Result	RL	Result	RL	Result	RL	Qual	Result	RL	Result	RL
Vinyl Chloride	0.15			<	0.12	<	0.12	<	0.12	22000		J	23000		<	31
Bromomethane	<	0.26		<	0.24	<	0.24	<	0.23	<	150		<	850	66	
Chloroethane	0.56			<	0.12	<	0.12	<	0.12	<	75		<	420	<	31
1,1-Dichloroethene	<	0.13		<	0.12	<	0.12	<	0.12	310			<	420	<	31
Carbon Disulfide	0.30			<	0.12	<	0.12	0.12		3000			6200		<	31
Acetone	3.7			1.5		1.2		2.5		<	750		<	4200	<	310
Methylene Chloride	<	0.13		<	0.12	<	0.12	<	0.12	<	75		<	420	<	31
trans-1,2-Dichloroethene	0.39			<	0.12	<	0.12	<	0.12	<	75		<	420	<	31
1,1-Dichloroethane	46		J	<	0.12	<	0.12	<	0.12	440			<	420	<	31
2-Butanone	<	1.3		<	1.17	<	1.16	<	1.15	<	750		<	4200	<	310
Chloroform	1.5	0.13		0.30	0.12	0.61	0.12	<	0.12	280			<	420	<	31
1,1,1-Trichloroethane	4.9	0.13		0.28	0.12	0.22	0.12	0.25	0.12	<	75		<	420	<	31
Carbon Tetrachloride	0.13	0.13		0.12	0.12	<	0.12	<	0.12	<	75		<	420	<	31
Benzene	0.93	0.13		<	0.12	<	0.12	<	0.12	220	75		<	420	<	31
1,2-Dichloroethane	<	0.13		<	0.12	<	0.12	<	0.12	<	75		<	420	<	31
Trichloroethene	3.5	0.13		<	0.12	<	0.12	<	0.12	15000	75	J	21000	420	90	31
1,2-Dichloropropane	<	0.13		<	0.12	<	0.12	<	0.12	<	75		<	420	<	31
trans-1,3-Dichloropropene	0.18	0.13		<	0.12	<	0.12	<	0.12	<	75		<	420	<	31
Toluene	0.28			<	0.12	<	0.12	<	0.12	11000			13000		<	31
cis-1,3-Dichloropropene	0.14			<	0.12	<	0.12	<	0.12	<	75		<	420	<	31
Tetrachloroethene	300		J	12		0.20		1.1		44000		J	80000		4000	
2-Hexanone	<	0.13		<	0.12	<	0.12	<	0.12	<	75		<	420	<	31
Chlorobenzene	<	0.13		<	0.12	<	0.12	<	0.12	<	75		<	420	<	31
Ethyl Benzene	<	0.13		<	0.12	<	0.12	<	0.12	10000			15000		<	31
m,p-Xylene	0.30			<	0.12	<	0.12	<	0.12	5700			8500		<	31
o-Xylene	<	0.13		<	0.12	<	0.12	<	0.12	1400			2000		<	31
Styrene	0.67			<	0.12	<	0.12	<	0.12	360.0			<	420	<	31
cis-1,2-Dichloroethene	<	0.13		<	0.12	<	0.12	<	0.12	1900			1700		<	31

J= Estimated Value
NR= Not measured
R= Rejected Value (The data is unusable.)

Table 5-1
Soil Gas Analytical Detections Summary - November 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-28		TT-29		TT-30		TT-31		TT-32			TT-33		TT-34		
Units	ug/m³		ug/m³		ug/m³		ug/m³		ug/m³			ug/m³		ug/m³		
	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Qual	Result	RL	Result	RL	Qual
Analyte																
Vinyl Chloride	<	2.4	<	0.30	<	0.31	<	0.31	18			<	3.4	220		
Bromomethane	<	4.7	<	0.60	<	0.62	<	0.62	<	1.9		<	6.9	<	9.0	
Chloroethane	<	2.4	<	0.30	<	0.31	<	0.31	2.7			3.8		5.7		
1,1-Dichloroethene	<	2.4	<	0.30	0.45		0.31		1.8			<	3.4	<	4.5	
Carbon Disulfide	7.1	2.4	<	1.5	<	0.95	<	1.1	9.9			7.3		29		
Acetone	<	23.6	<	3.0	<	3.1	<	3.1	<	9.4		<	34.0	<	45	
Methylene Chloride	<	2.4	<	0.30	<	0.31	<	0.3	<	0.94		<	3.4	<	4.5	
trans-1,2-Dichloroethene	<	2.4	<	0.30	0.52		0.45		4.0			6.9		21		
1,1-Dichloroethane	<	2.4	<	0.30	<	0.31	<	0.3	360		J	9.2		47		
2-Butanone	<	23.6	<	2.98	<	3.1	<	3.1	<	9.4		<	34	<	45	
Chloroform	<	2.4	<	0.30	<	0.31	<	0.31	<	0.94		<	3.4	<	4.5	
1,1,1-Trichloroethane	<	2.4	7.3	0.30	<	0.31	<	0.31	<	0.94		<	3.4	<	4.5	
Carbon Tetrachloride	<	2.4	<	0.30	<	0.31	<	0.31	<	0.94		<	3.4	<	4.5	
Benzene	100		1.5		1.9		2.0		41			210		750		
1,2-Dichloroethane	<	2.4	<	0.30	<	0.31	<	0.31	1.7		R	<	3.4	<	4.5	
Trichloroethene	14		<	0.30	<	0.31	<	0.31	16			8.7		43		
1,2-Dichloropropane	<	2.4	<	0.30	<	0.31	<	0.31	9.9			<	3.4	<	4.5	
trans-1,3-Dichloropropene	<	2.4	<	0.30	<	0.31	<	0.31	<	0.94		<	3.4	<	4.5	
Toluene	6.6		0.33		0.67		0.67		4.0			20		190		
cis-1,3-Dichloropropene	<	2.4	<	0.30	<	0.31	<	0.31	<	0.94		<	3.4	<	4.5	
Tetrachloroethene	61		230		<	0.31	<	0.31	1.7		B	<	3.4	380		
2-Hexanone	<	2.4	<	0.30	<	0.31	<	0.31	<	0.94		<	3.4	<	4.5	
Chlorobenzene	<	2.4	<	0.30	<	0.31	<	0.31	11			18		<	4.5	
Ethyl Benzene	52		<	0.30	0.81		0.63		1.8	0.94		22		1000		J
m,p-Xylene	52		0.51	0.30	1.5		1.3		4.5	0.94		64		900		
o-Xylene	31		<	0.30	0.76		0.53		4.7	0.94		4.6		340		
Styrene	2.6		<	0.30	<	0.31	<	0.31	<	0.94		<	3.4	<	4.5	
cis-1,2-Dichloroethene	5.7		<	0.30	0.44		0.33		8.9	0.94		9.2		38		

J= Estimated Value
NR= Not measured
R= Rejected Value (The data is unusable.)

Table 5-1
Soil Gas Analytical Detections Summary - November 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-35		TT-36		TT-37			TT-38		TT-39			TT-39 (Dup)		
Units	ug/m³		ug/m³		ug/m³			ug/m³		ug/m³			ug/m³		
	Result	RL	Result	RL	Result	RL	Qual	Result	RL	Result	RL	Qual	Result	RL	Qual
Analyte															
Vinyl Chloride	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
Bromomethane	<	0.44	<	0.44	<	0.44		<	0.45	<	0.44		<	0.44	
Chloroethane	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
1,1-Dichloroethene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
Carbon Disulfide	**1.2**		<	0.22	**0.61**			**0.63**		**0.45**			**0.26**		
Acetone	<	2.2	<	2.2	<	2.2		<	2.3	<	2.2		<	2.2	
Methylene Chloride	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
trans-1,2-Dichloroethene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
1,1-Dichloroethane	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
2-Butanone	<	2.2	<	2.2	<	2.2		<	2.3	<	2.2		<	2.2	
Chloroform	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
1,1,1-Trichloroethane	<	0.22	**0.32**		**0.83**			**0.68**		**0.76**			**0.67**		
Carbon Tetrachloride	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
Benzene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
1,2-Dichloroethane	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
Trichloroethene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
1,2-Dichloropropane	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
trans-1,3-Dichloropropene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
Toluene	<	0.45	<	0.23	<	0.41		<	0.35	**2.4**			**0.71**		
cis-1,3-Dichloropropene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
Tetrachloroethene	**0.76**		**2.7**		**130**		J	**14**		**110**		J	**89**		J
2-Hexanone	**1.8**		<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
Chlorobenzene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
Ethyl Benzene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
m,p-Xylene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
o-Xylene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
Styrene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	
cis-1,2-Dichloroethene	<	0.22	<	0.22	<	0.22		<	0.23	<	0.22		<	0.22	

J= Estimated Value
NR= Not measured
R= Rejected Value (The data is unusable.)

Table 5-1
Soil Gas Analytical Detections Summary - November 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-40			TT-41		TT-42		TT-43		TT-44		TT-45		
Units	ug/m3			ug/m3		ug/m3		ug/m3		ug/m3		ug/m3		
	Result	RL	Qual	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Qual
Analyte														
Vinyl Chloride	<	0.23		<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
Bromomethane	<	0.45		<	0.41	**0.61**		<	0.44	<	0.45	<	0.43	
Chloroethane	<	0.23		<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
1,1-Dichloroethene	**0.50**			<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
Carbon Disulfide	**0.72**			**1.3**		**0.23**		**0.61**		**0.28**		**0.57**		
Acetone	<	2.3		<	2.0	<	2.2	<	2.2	<	2.3	<	2.2	
Methylene Chloride	**1.4**			<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
trans-1,2-Dichloroethene	**2.5**			<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
1,1-Dichloroethane	**4.2**			<	0.2	<	0.22	<	0.22	<	0.23	**2.6**		
2-Butanone	<	2.3		<	2.0	<	2.2	<	2.2	<	2.3	<	2.2	
Chloroform	**2.9**			<	0.2	**1.6**		<	0.22	<	0.23	**1.0**		
1,1,1-Trichloroethane	**9.1**			**0.26**		**0.25**		**0.22**		<	0.23	**100**		J
Carbon Tetrachloride	<	0.23		<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
Benzene	**1.1**			<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
1,2-Dichloroethane	<	0.23		<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
Trichloroethene	**77**		J	<	0.2	<	0.22	<	0.22	<	0.23	**1.6**		
1,2-Dichloropropane	<	0.23		<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
trans-1,3-Dichloropropene	<	0.23		<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
Toluene	**2.5**			**0.36**		**0.87**		**0.70**		**0.73**		**0.42**		
cis-1,3-Dichloropropene	<	0.23		<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
Tetrachloroethene	**1100**		J	<	0.2	**1.0**		**10**		**1.4**		**1.2**		
2-Hexanone	<	0.23		<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
Chlorobenzene	<	0.23		<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
Ethyl Benzene	**0.63**			<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
m,p-Xylene	**0.91**			<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
o-Xylene	**0.38**			<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
Styrene	<	0.23		<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	
cis-1,2-Dichloroethene	**7.7**			<	0.2	<	0.22	<	0.22	<	0.23	<	0.22	

J= Estimated Value
NR= Not measured
R= Rejected Value (The data is unusable.)

Table 5-1
Soil Gas Analytical Detections Summary - November 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-46		TT-46 (Duplicate)		TT-47			TT-48		TT-49			TT-50		TT-51	
Units	ug/m³		ug/m³		ug/m³			ug/m³		ug/m³			ug/m³		ug/m³	
	Result	RL	Result	RL	Result	RL	Qual	Result	RL	Result	RL	Qual	Result	RL	Result	RL
Analyte																
Vinyl Chloride	<	0.22	<	0.22	<	0.23		<	0.22	<	0.21		<	0.21	<	0.23
Bromomethane	<	0.45	<	0.45	**0.63**			<	0.43	**0.81**			<	0.43	<	0.45
Chloroethane	<	0.22	<	0.22	<	0.23		<	0.22	**4.3**			<	0.21	<	0.23
1,1-Dichloroethene	<	0.22	<	0.22	<	0.23		<	0.22	**0.56**			<	0.21	<	0.23
Carbon Disulfide	**1.4**		**0.63**		**1.2**			**1.1**		**1.2**			**0.25**		**0.44**	
Acetone	**2.3**		<	2.2	<	2.3		<	2.2	<	2.1		<	2.1	<	2.3
Methylene Chloride	<	0.22	<	0.22	<	0.23		<	0.22	<	0.21		<	0.21	<	0.23
trans-1,2-Dichloroethene	<	0.22	<	0.22	<	0.23		<	0.22	**0.51**			<	0.21	<	0.23
1,1-Dichloroethane	**1.5**		**0.94**		**6.8**			**4.7**		**280**		J	**0.32**		**9.0**	
2-Butanone	<	2.25	<	2.2	<	2.3		<	2.2	<	2.1		<	2.1	<	2.3
Chloroform	**1.7**		**1.0**		**2.4**			**0.22**		<	0.21		<	0.21	<	0.23
1,1,1-Trichloroethane	**5.9**		**3.4**		**68**		J	**6.0**		**7.3**			**0.27**		**0.37**	
Carbon Tetrachloride	<	0.22	<	0.22	<	0.23		<	0.22	<	0.21		<	0.21	<	0.23
Benzene	**0.27**		<	0.22	<	0.23		**0.99**		**6.0**			**0.22**		**0.45**	
1,2-Dichloroethane	<	0.22	<	0.22	<	0.23		<	0.22	**0.38**			<	0.21	<	0.23
Trichloroethene	**0.28**		<	0.22	<	0.23		**2.8**		**40**			**1.0**		<	0.23
1,2-Dichloropropane	<	0.22	<	0.22	<	0.23		<	0.22	**4.7**			<	0.21	<	0.23
trans-1,3-Dichloropropene	<	0.22	<	0.22	<	0.23		<	0.22	<	0.21		<	0.21	<	0.23
Toluene	**3.6**		**0.80**		**1.2**			**6.9**		**1.2**			**0.40**		**0.45**	
cis-1,3-Dichloropropene	<	0.22	<	0.22	<	0.23		<	0.22	<	0.21		<	0.21	<	0.23
Tetrachloroethene	**7.2**		**5.4**		**2.0**			**4.7**		**39**			**2.1**		**1.8**	
2-Hexanone	<	0.22	<	0.22	<	0.23		<	0.22	<	0.21		<	0.21	<	0.23
Chlorobenzene	<	0.22	<	0.22	<	0.23		<	0.22	<	0.21		<	0.21	<	0.23
Ethyl Benzene	**0.30**		<	0.22	<	0.23		**0.37**		**6.0**			<	0.21	<	0.23
m,p-Xylene	**0.54**		<	0.22	<	0.23		<	0.22	**9.4**			<	0.21	<	0.23
o-Xylene	<	0.22	<	0.22	<	0.23		<	0.22	**3.6**			<	0.21	<	0.23
Styrene	<	0.22	<	0.22	<	0.23		<	0.22	<	0.21		<	0.21	<	0.23
cis-1,2-Dichloroethene	<	0.22	<	0.22	<	0.23		<	0.22	**2.8**			<	0.21	<	0.23

J= Estimated Value
NR= Not measured
R= Rejected Value (The data is unusable.)

Table 5-1
Soil Gas Analytical Detections Summary - November 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-62		TT-63	
Units	ug/m³		ug/m³	
	Result	RL	Result	RL
Analyte				
Vinyl Chloride	<	0.23	<	0.22
Bromomethane	<	0.45	<	0.45
Chloroethane	<	0.45	<	0.22
1,1-Dichloroethene	<	0.23	<	0.22
Carbon Disulfide	0.50		<	0.22
Acetone	<	2.3	<	2.2
Methylene Chloride	<	0.23	<	0.22
trans-1,2-Dichloroethene	<	0.23	<	0.22
1,1-Dichloroethane	<	0.23	<	0.22
2-Butanone	<	2.3	<	2.2
Chloroform	<	0.23	<	0.22
1,1,1-Trichloroethane	<	0.23	<	0.22
Carbon Tetrachloride	<	0.23	<	0.22
Benzene	<	0.23	<	0.22
1,2-Dichloroethane	<	0.23	<	0.22
Trichloroethene	<	0.23	<	0.22
1,2-Dichloropropane	<	0.23	<	0.22
trans-1,3-Dichloropropene	<	0.23	<	0.22
Toluene	<	0.23	<	0.22
cis-1,3-Dichloropropene	<	0.23	<	0.22
Tetrachloroethene	<	0.23	<	0.22
2-Hexanone	<	0.23	<	0.22
Chlorobenzene	<	0.23	<	0.22
Ethyl Benzene	<	0.23	<	0.22
m,p-Xylene	<	0.23	<	0.22
o-Xylene	<	0.23	<	0.22
Styrene	<	0.23	<	0.22
cis-1,2-Dichloroethene	<	0.23	<	0.22

J= Estimated Value
NR= Not measured
R= Rejected Value (The data is unusable.)

Table 5-2
Soil Gas Analytical Detections Summary - October 1999
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-54			TT-61/TT-54			TT-55			TT-56			TT-56 Duplicate			TT-57		
Sample Tube Numbers	11009A			11021A&11009B			11014A&B			11003A&B			11005A&B			11108A&B		
Compound - Units	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual
Chloromethane	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
Vinyl Chloride	<	0.48		<	0.47		<	0.44		20000	0.81		16000	0.89		<	0.46	
Bromomethane	<	0.48		<	0.47		<	0.44		11	0.81		<	0.89		<	0.46	
Chloroethane	<	0.48		<	0.47		<	0.44		530	0.81		<	0.89		<	0.46	
Freon 11	<	0.48		3.8	0.47	J	0.85	0.44		370	0.81		<	0.89		1.1	0.46	
1,1-Dichloroethene	<	0.48		<	0.47		<	0.44		1900	0.81		<	0.89		<	0.46	
Carbon Disulfide	1.1	0.48	J	0.71	0.47	J	0.71	0.44		19000	0.81		9800	0.89		<	0.46	
Acetone	<	2.4		3.3	2.4	J	<	2.2		<	4.1		<	4.5		4.6	2.3	
Methylene Chloride	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
trans-1,2-Dichloroethene	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
1,1-Dichloroethane	<	0.48		<	0.47		<	0.44		1500	0.81		<	0.89		<	0.46	
Vinyl Acetate	<	0.48		<	0.5		<	0.44		<	0.81		<	0.89		<	0.46	
2-Butanone	<	2.4		<	2.4		<	0.44		<	4.1		<	4.5		2.7	2.3	
Chloroform	<	0.48		<	0.47		<	0.44		110	0.81		<	0.89		<	0.46	
1,1,1-Trichloroethane	<	0.48		0.57	0.47	J	<	0.44		<	0.81		<	0.89		<	0.46	
Carbon Tetrachloride	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
Benzene	<	0.48		<	0.47		<	0.44		380	0.81		<	0.89		<	0.46	
1,2-Dichloroethane	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
Trichloroethene	<	0.48		<	0.47		<	0.44		6600	0.81		14000	0.89		<	0.46	
1,2-Dichloropropane	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
Bromodichloromethane	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
trans-1,3-Dichloropropene	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
4-Methyl-2-pentanone	<	2.4		<	2.4		<	2.2		<	4.1		<	4.5		<	2.3	
Toluene	0.58	0.48	J	0.57	0.47	J	<	0.44		2800	0.81		6800	0.89		<	0.46	
cis-1,3-Dichloropropene	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
1,1,2-Trichloroethane	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
Tetrachloroethene	<	0.48		76	0.47	JE	<	0.44		6000	0.81		34884	0.89		<	0.46	
2-Hexanone	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
Dibromochloromethane	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
Chlorobenzene	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
Ethyl Benzene	<	0.48		<	0.47		<	0.44		1400	0.81		6400	0.89		<	0.46	
m,p-Xylene	<	0.48		<	0.47		<	0.44		900	0.81		4500	0.89		<	0.46	
o-Xylene	<	0.48		<	0.47		<	0.44		270	0.81		980	0.89		<	0.46	
Styrene	<	0.48		<	0.47		<	0.44		90	0.81		<	0.89		<	0.46	
Bromoform	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
1,1,2,2-Tetrachloroethane	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
1,3-Dichlorobenzene	<	0.48		<	0.47		<	0.44		<	0.81		<	0.89		<	0.46	
1,4-Dichlorobenzene	<	0.48		<	0.47		<	0.44		50	0.81		<	0.89		<	0.46	
1,2-Dichlorobenzene	<	0.48		<	0.47		<	0.44		3.4	0.81		<	0.89		<	0.46	
cis-1,2-Dichloroethene	<	0.48		<	0.47		<	0.44		4200	0.81		2200	0.89		<	0.46	

E: Exceeds instrument calibration
J: Estimated Value
RL: Reporting Limit
NS: Not Sampled
NR: Not Reported
NA: Not Applicable
<: Not detected.

Table 5-2
Soil Gas Analytical Detections Summary - October 1999
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-58			TT-59			TT-60			TT-61			TT-62			TT-63		
Sample Tube Numbers	11019A&B			11105A&B			11022A&B			11021B			11107 A&B			11104A&B		
Compound - Units	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual
Chloromethane	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Vinyl Chloride	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Bromomethane	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Chloroethane	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Freon 11	3.1	0.47		0.76	0.47		0.78	0.46		1.1	0.47	J	90	0.47		190	0.47	
1,1-Dichloroethene	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Carbon Disulfide	0.66	0.47		4.7	0.47		0.96	0.46		<	0.47		1.2	0.47		0.84	0.47	
Acetone	2.9	2.4		4.4	2.4		4.3	2.3		<	2.3		7.1	2.4		<	2.3	
Methylene Chloride	<	0.47		<	0.47		0.59	0.46		<	0.47		4.7	0.47		<	0.47	
trans-1,2-Dichloroethene	<	0.47		<	0.47		<	0.46		<	0.47		7.1	0.47		<	0.47	
1,1-Dichloroethane	<	0.47		<	0.47		<	0.46		<	0.47		5.7	0.47		3.4	0.47	
Vinyl Acetate	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
2-Butanone	<	2.4		2.8	2.4		2.5	2.3		<	2.3		6.1	2.4		<	2.3	
Chloroform	<	0.47		<	0.47		<	0.46		<	0.47		3.1	0.47		1.4	0.47	
1,1,1-Trichloroethane	<	0.47		<	0.47		<	0.46		<	0.47		12	0.47		2.2	0.47	
Carbon Tetrachloride	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Benzene	<	0.47		0.62	0.47		<	0.46		<	0.47		1.8	0.47		<	0.47	
1,2-Dichloroethane	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Trichloroethene	<	0.47		<	0.47		<	0.46		<	0.47		40	0.47		0.75	0.47	
1,2-Dichloropropane	<	0.47		<	0.47		<	0.46		<	0.47		1.2	0.47		<	0.47	
Bromodichloromethane	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
trans-1,3-Dichloropropene	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
4-Methyl-2-pentanone	<	2.4		<	2.4		<	2.3		<	2.3		3.1	2.4		<	2.3	
Toluene	<	0.47		0.85	0.47		<	0.46		<	0.47		20	0.47		5.1	0.47	
cis-1,3-Dichloropropene	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
1,1,2-Trichloroethane	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Tetrachloroethene	<	0.47		<	0.47		0.50	0.46		1.6	0.47	J	990	0.47		120	0.47	
2-Hexanone	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Dibromochloromethane	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Chlorobenzene	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
Ethyl Benzene	<	0.47		0.52	0.47		<	0.46		<	0.47		14	0.47		<	0.47	
m,p-Xylene	<	0.47		<	0.47		<	0.46		<	0.47		3.9	0.47		<	0.47	
o-Xylene	<	0.47		<	0.47		<	0.46		<	0.47		1.3	0.47		<	0.47	
Styrene	<	0.47		0.57	0.47		<	0.46		<	0.47		57	0.47		<	0.47	
Bromoform	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
1,1,2,2-Tetrachloroethane	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
1,3-Dichlorobenzene	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
1,4-Dichlorobenzene	<	0.47		<	0.47		<	0.46		<	0.47		2.7	0.47		<	0.47	
1,2-Dichlorobenzene	<	0.47		<	0.47		<	0.46		<	0.47		<	0.47		<	0.47	
cis-1,2-Dichloroethene	<	0.47		<	0.47		<	0.46		<	0.47		24	0.47		<	0.47	

E: Exceeds instrument calibration
J: Estimated Value
RL: Reporting Limit
NS: Not Sampled
NR: Not Reported
NA: Not Applicable
<: Not detected.

Table 5-2
Soil Gas Analytical Detections Summary - October 1999
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-64			TT-65			TT-66			TT-67			TT-68			TT-69		
Sample Tube Numbers	11015A&B			11002A&B			11024A&B			11017A&B			11110A&B			11214A&B		
Compound - Units	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual
Chloromethane	<	0.50		<	0.49		<	0.49		<	0.48		3.0	0.48		<	0.45	
Vinyl Chloride	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Bromomethane	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Chloroethane	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Freon 11	1.0	0.50		0.59	0.49		0.68	0.49		1.3	0.48		1.1	0.48		0.77	0.45	
1,1-Dichloroethene	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Carbon Disulfide	1.7	0.50		1.4	0.49		<	0.49		<	0.48		0.53	0.48		0.45	0.45	
Acetone	9.0	2.5		<	2.4		<	2.4		4.5	2.4		6.2	2.4		<	2.3	
Methylene Chloride	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
trans-1,2-Dichloroethene	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
1,1-Dichloroethane	22	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Vinyl Acetate	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
2-Butanone	3.0	2.5		<	2.4		1.7	2.4		2.7	2.4		3.0	2.4		<	2.3	
Chloroform	7.5	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
1,1,1-Trichloroethane	0.65	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Carbon Tetrachloride	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Benzene	0.50	0.50		0.64	0.49		<	0.49		<	0.48		1.06	0.48		<	0.45	
1,2-Dichloroethane	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Trichloroethene	29	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
1,2-Dichloropropane	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Bromodichloromethane	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
trans-1,3-Dichloropropene	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
4-Methyl-2-pentanone	<	2.5		<	2.4		<	2.4		<	2.4		<	2.4		<	2.3	
Toluene	6.5	0.50		4.9	0.49		<	0.49		<	0.48		0.86	0.48		<	0.45	
cis-1,3-Dichloropropene	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
1,1,2-Trichloroethane	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Tetrachloroethene	140	0.50		<	0.49		<	0.49		0.57	0.48		0.48	0.48		0.45	0.45	
2-Hexanone	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Dibromochloromethane	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Chlorobenzene	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Ethyl Benzene	1.4	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
m,p-Xylene	1.6	0.50		1.7	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
o-Xylene	1.1	0.50		0.54	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Styrene	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
Bromoform	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
1,1,2,2-Tetrachloroethane	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
1,3-Dichlorobenzene	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
1,4-Dichlorobenzene	16	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
1,2-Dichlorobenzene	<	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	
cis-1,2-Dichloroethene	0.75	0.50		<	0.49		<	0.49		<	0.48		<	0.48		<	0.45	

E: Exceeds instrument calibration
J: Estimated Value
RL: Reporting Limit
NS: Not Sampled
NR: Not Reported
NA: Not Applicable
<: Not detected.

Table 5-2
Soil Gas Analytical Detections Summary - October 1999
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-70			TT-71			TT-72			TT-73			TT-74			TT-75		
Sample Tube Numbers	11006A&B			11023A&B			11013A&B			11008A&B			11106A&B			11218A&B		
Compound - Units	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual
Chloromethane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Vinyl Chloride	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Bromomethane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Chloroethane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Freon 11	0.62	0.51		0.85	0.47		0.86	0.48		0.61	0.47		0.68	0.48		0.71	0.44	
1,1-Dichloroethene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Carbon Disulfide	0.82	0.51		1.1	0.47		1.2	0.48		<	0.47		<	0.48		0.49	0.44	
Acetone	3.0	2.6		4.7	2.3		<	2.4		<	2.3		<	2.4		5.3	2.2	
Methylene Chloride	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
trans-1,2-Dichloroethene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
1,1-Dichloroethane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Vinyl Acetate	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
2-Butanone	<	2.6		<	2.3		<	2.4		<	2.3		<	2.4		<	2.2	
Chloroform	<	0.51		<	0.47		<	0.48		0.66	0.47		<	0.48		1.4	0.44	
1,1,1-Trichloroethane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		0.80	0.44	
Carbon Tetrachloride	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Benzene	<	0.51		0.47	0.47		<	0.48		2.2	0.47		<	0.48		<	0.44	
1,2-Dichloroethane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Trichloroethene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
1,2-Dichloropropane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Bromodichloromethane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
trans-1,3-Dichloropropene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
4-Methyl-2-pentanone	<	2.6		<	2.3		<	2.4		<	2.3		<	2.4		<	2.2	
Toluene	<	0.51		0.89	0.47		0.77	0.48		4.6	0.47		<	0.48		<	0.44	
cis-1,3-Dichloropropene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
1,1,2-Trichloroethane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Tetrachloroethene	<	0.51		32	0.47		25	0.48		<	0.47		<	0.48		<	0.44	
2-Hexanone	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Dibromochloromethane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Chlorobenzene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Ethyl Benzene	<	0.51		0.66	0.47		<	0.48		1.5	0.47		<	0.48		<	0.44	
m,p-Xylene	0.62	0.51		<	0.47		<	0.48		2.3	0.47		<	0.48		<	0.44	
o-Xylene	<	0.51		<	0.47		<	0.48		0.85	0.47		<	0.48		<	0.44	
Styrene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
Bromoform	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
1,1,2,2-Tetrachloroethane	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
1,3-Dichlorobenzene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
1,4-Dichlorobenzene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
1,2-Dichlorobenzene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	
cis-1,2-Dichloroethene	<	0.51		<	0.47		<	0.48		<	0.47		<	0.48		<	0.44	

E: Exceeds instrument calibration
J: Estimated Value
RL: Reporting Limit
NS: Not Sampled
NR: Not Reported
NA: Not Applicable
<: Not detected.

Table 5-2
Soil Gas Analytical Detections Summary - October 1999
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-76			TT-77			TT-78			TT-79			TT-80			TT-81		
Sample Tube Numbers	11206A&B			11211A&B			11225A&B			11210A&B			11223A&B			11201A&B		
Compound - Units	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual
Chloromethane	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Vinyl Chloride	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Bromomethane	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Chloroethane	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Freon 11	0.90	0.45		1.6	0.48		1.4	0.49		5.6	0.47		1.7	0.48		0.75	0.47	
1,1-Dichloroethene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Carbon Disulfide	0.99	0.45		0.86	0.48		1.6	0.49		<	0.47		0.53	0.48		1.2	0.47	
Acetone	<	2.4		<	2.4		4.0	2.5		<	2.3		<	2.4		<	2.4	
Methylene Chloride	<	0.45		<	0.48		0.64	0.49		<	0.47		0.53	0.48		0.47	0.47	
trans-1,2-Dichloroethene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
1,1-Dichloroethane	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Vinyl Acetate	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
2-Butanone	<	2.4		<	2.4		<	2.5		<	2.3		<	2.4		<	2.4	
Chloroform	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
1,1,1-Trichloroethane	<	0.45		<	0.48		<	0.49		0.51	0.47		<	0.48		<	0.47	
Carbon Tetrachloride	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Benzene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
1,2-Dichloroethane	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Trichloroethene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
1,2-Dichloropropane	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Bromodichloromethane	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
trans-1,3-Dichloropropene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
4-Methyl-2-pentanone	<	2.4		<	2.4		<	2.5		<	2.3		<	2.4		<	2.4	
Toluene	<	0.45		<	0.48		8.8	0.49		<	0.47		<	0.48		<	0.47	
cis-1,3-Dichloropropene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
1,1,2-Trichloroethane	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Tetrachloroethene	<	0.45		5.7	0.48		30	0.49		19	0.47		1.2	0.48		0.52	0.47	
2-Hexanone	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Dibromochloromethane	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Chlorobenzene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Ethyl Benzene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
m,p-Xylene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
o-Xylene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Styrene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
Bromoform	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
1,1,2,2-Tetrachloroethane	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
1,3-Dichlorobenzene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
1,4-Dichlorobenzene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
1,2-Dichlorobenzene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	
cis-1,2-Dichloroethene	<	0.45		<	0.48		<	0.49		<	0.47		<	0.48		<	0.47	

E: Exceeds instrument calibration
J: Estimated Value
RL: Reporting Limit
NS: Not Sampled
NR: Not Reported
NA: Not Applicable
<: Not detected.

Table 5-2
Soil Gas Analytical Detections Summary - October 1999
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-82			TT-83			TT-84			TT-85		TT-86			TT-87		
Sample Tube Numbers	11004A&B			11111A&B			11102A&B					11215A&B			11224A&B		
Compound - Units	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	µg/m³	RL	Qual	µg/m³	RL	Qual
Chloromethane	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Vinyl Chloride	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Bromomethane	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Chloroethane	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Freon 11	0.72	0.48		0.51	0.47		0.65	0.46		NR	NA	3.3	0.46		1.2	0.47	
1,1-Dichloroethene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Carbon Disulfide	2.2	0.48		2.7	0.47		1.8	0.46		NR	NA	3.7	0.46		0.94	0.47	
Acetone	<	2.4		<	2.3		<	2.3		NR	NA	4.3	2.3		<	2.4	
Methylene Chloride	0.53	0.48		0.51	0.47		1.8	0.46		NR	NA	<	0.46		<	0.47	
trans-1,2-Dichloroethene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
1,1-Dichloroethane	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Vinyl Acetate	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
2-Butanone	<	2.4		<	2.3		<	2.3		NR	NA	<	2.3		<	2.4	
Chloroform	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
1,1,1-Trichloroethane	<	0.48		<	0.47		<	0.46		NR	NA	2.4	0.46		<	0.47	
Carbon Tetrachloride	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Benzene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
1,2-Dichloroethane	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Trichloroethene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
1,2-Dichloropropane	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Bromodichloromethane	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
trans-1,3-Dichloropropene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
4-Methyl-2-pentanone	<	2.4		<	2.3		<	2.3		NR	NA	<	2.3		<	2.4	
Toluene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
cis-1,3-Dichloropropene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
1,1,2-Trichloroethane	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Tetrachloroethene	<	0.48		<	0.47		<	0.46		NR	NA	0.69	0.46		0.61	0.47	
2-Hexanone	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Dibromochloromethane	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Chlorobenzene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Ethyl Benzene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
m,p-Xylene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
o-Xylene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Styrene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
Bromoform	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
1,1,2,2-Tetrachloroethane	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
1,3-Dichlorobenzene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
1,4-Dichlorobenzene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
1,2-Dichlorobenzene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	
cis-1,2-Dichloroethene	<	0.48		<	0.47		<	0.46		NR	NA	<	0.46		<	0.47	

E: Exceeds instrument calibration
J: Estimated Value
RL: Reporting Limit
NS: Not Sampled
NR: Not Reported
NA: Not Applicable
<: Not detected.

Table 5-2
Soil Gas Analytical Detections Summary - October 1999
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-88		TT-89			TT-90			TT-91			TT-92			TT-93		TT-94	
Sample Tube Numbers	NS		11313A&B			11222A&B			11315A&B			11207A&B			NS		NS	
Compound - Units	µg/m³	RL	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	µg/m³	RL
Chloromethane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Vinyl Chloride	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Bromomethane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Chloroethane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Freon 11	NS	NA	1.5	0.46		1.7	0.50		1.0	0.47		2.1	0.47		NS	NA	NS	NA
1,1-Dichloroethene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Carbon Disulfide	NS	NA	<	0.46		1.9	0.50		<	0.47		1.4	0.47		NS	NA	NS	NA
Acetone	NS	NA	<	2.3		2.8	2.5		<	2.4		<	2.4		NS	NA	NS	NA
Methylene Chloride	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
trans-1,2-Dichloroethene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
1,1-Dichloroethane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Vinyl Acetate	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
2-Butanone	NS	NA	<	2.3		<	2.5		<	2.4		<	2.4		NS	NA	NS	NA
Chloroform	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
1,1,1-Trichloroethane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Carbon Tetrachloride	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Benzene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
1,2-Dichloroethane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Trichloroethene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
1,2-Dichloropropane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Bromodichloromethane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
trans-1,3-Dichloropropene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
4-Methyl-2-pentanone	NS	NA	<	2.3		<	2.5		<	2.4		<	2.4		NS	NA	NS	NA
Toluene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
cis-1,3-Dichloropropene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
1,1,2-Trichloroethane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Tetrachloroethene	NS	NA	<	0.46		0.65	0.50		0.90	0.47		<	0.47		NS	NA	NS	NA
2-Hexanone	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Dibromochloromethane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Chlorobenzene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Ethyl Benzene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
m,p-Xylene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
o-Xylene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Styrene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
Bromoform	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
1,1,2,2-Tetrachloroethane	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
1,3-Dichlorobenzene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
1,4-Dichlorobenzene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
1,2-Dichlorobenzene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA
cis-1,2-Dichloroethene	NS	NA	<	0.46		<	0.50		<	0.47		<	0.47		NS	NA	NS	NA

E: Exceeds instrument calibration
J: Estimated Value
RL: Reporting Limit
NS: Not Sampled
NR: Not Reported
NA: Not Applicable
<: Not detected.

Table 5-2
Soil Gas Analytical Detections Summary - October 1999
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-95			TT-95 Duplicate			TT-96			TT-97			TT-97 Duplicate			TT-98		
Sample Tube Numbers	11317A&B			11304A&B			11217A&B			11310A&B			11205A&B			11203A&B		
Compound - Units	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual
Chloromethane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Vinyl Chloride	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Bromomethane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Chloroethane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Freon 11	0.70	0.46		0.61	0.44		1.5	0.48		1.3	0.48		2.0	0.49		0.99	0.50	
1,1-Dichloroethene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Carbon Disulfide	<	0.46		1.4	0.44		1.1	0.48		4.4	0.48		2.7	0.49		3.3	0.50	
Acetone	<	2.2		<	2.3		2.7	2.4		<	2.4		3.2	2.5		<	2.5	
Methylene Chloride	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
trans-1,2-Dichloroethene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
1,1-Dichloroethane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Vinyl Acetate	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
2-Butanone	<	2.2		<	2.3		<	2.4		<	2.4		<	2.5		<	2.5	
Chloroform	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
1,1,1-Trichloroethane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Carbon Tetrachloride	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Benzene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
1,2-Dichloroethane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Trichloroethene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
1,2-Dichloropropane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Bromodichloromethane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
trans-1,3-Dichloropropene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
4-Methyl-2-pentanone	<	2.2		<	2.3		<	2.4		<	2.4		<	2.5		<	2.5	
Toluene	0.83	0.46		0.48	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
cis-1,3-Dichloropropene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
1,1,2-Trichloroethane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Tetrachloroethene	1.3	0.46		1.6	0.44		<	0.48		0.82	0.48		0.69	0.49		<	0.50	
2-Hexanone	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Dibromochloromethane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Chlorobenzene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Ethyl Benzene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
m,p-Xylene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
o-Xylene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Styrene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
Bromoform	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
1,1,2,2-Tetrachloroethane	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
1,3-Dichlorobenzene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
1,4-Dichlorobenzene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
1,2-Dichlorobenzene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	
cis-1,2-Dichloroethene	<	0.46		<	0.44		<	0.48		<	0.48		<	0.49		<	0.50	

E: Exceeds instrument calibration
J: Estimated Value
RL: Reporting Limit
NS: Not Sampled
NR: Not Reported
NA: Not Applicable
<: Not detected.

Table 5-2
Soil Gas Analytical Detections Summary - October 1999
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample Location	TT-99		TT-100			TT-101			TT-102		
Sample Tube Numbers	NS		11311A&B			11212A&B			11216A&B		
Compound - Units	µg/m³	RL	µg/m³	RL	Qual	µg/m³	RL	Qual	µg/m³	RL	Qual
Chloromethane	NS	NA	<	0.48		<	0.49		<	0.46	
Vinyl Chloride	<		<	0.48		<	0.49		<	0.46	
Bromomethane	<		<	0.48		<	0.49		<	0.46	
Chloroethane	<		<	0.48		<	0.49		<	0.46	
Freon 11	<		0.72	0.48		0.98	0.49		1.1	0.46	
1,1-Dichloroethene	<		<	0.48		<	0.49		<	0.46	
Carbon Disulfide	<		<	0.48		1.1	0.49		0.87	0.46	
Acetone	<		<	2.4		6.8	2.4		<	2.3	
Methylene Chloride	<		<	0.48		<	0.49		<	0.46	
trans-1,2-Dichloroethene	<		<	0.48		<	0.49		<	0.46	
1,1-Dichloroethane	<		<	0.48		<	0.49		<	0.46	
Vinyl Acetate	<		<	0.48		<	0.49		<	0.46	
2-Butanone	<		<	2.4		<	2.4		<	2.3	
Chloroform	<		<	0.48		<	0.49		<	0.46	
1,1,1-Trichloroethane	<		<	0.48		<	0.49		0.82	0.46	
Carbon Tetrachloride	<		<	0.48		<	0.49		<	0.46	
Benzene	<		<	0.48		<	0.49		<	0.46	
1,2-Dichloroethane	<		<	0.48		<	0.49		<	0.46	
Trichloroethene	<		<	0.48		<	0.49		<	0.46	
1,2-Dichloropropane	<		<	0.48		<	0.49		<	0.46	
Bromodichloromethane	<		<	0.48		<	0.49		<	0.46	
trans-1,3-Dichloropropene	<		<	0.48		<	0.49		<	0.46	
4-Methyl-2-pentanone	<		<	2.4		<	2.4		<	2.3	
Toluene	<		<	0.48		<	0.49		<	0.46	
cis-1,3-Dichloropropene	<		<	0.48		<	0.49		<	0.46	
1,1,2-Trichloroethane	<		<	0.48		<	0.49		<	0.46	
Tetrachloroethene	<		<	0.48		<	0.49		<	0.46	
2-Hexanone	<		<	0.48		<	0.49		<	0.46	
Dibromochloromethane	<		<	0.48		<	0.49		<	0.46	
Chlorobenzene	<		<	0.48		<	0.49		<	0.46	
Ethyl Benzene	<		<	0.48		<	0.49		<	0.46	
m,p-Xylene	<		<	0.48		<	0.49		<	0.46	
o-Xylene	<		<	0.48		<	0.49		<	0.46	
Styrene	<		<	0.48		<	0.49		<	0.46	
Bromoform	<		<	0.48		<	0.49		<	0.46	
1,1,2,2-Tetrachloroethane	<		<	0.48		<	0.49		<	0.46	
1,3-Dichlorobenzene	<		<	0.48		<	0.49		<	0.46	
1,4-Dichlorobenzene	<		<	0.48		<	0.49		<	0.46	
1,2-Dichlorobenzene	<		<	0.48		<	0.49		<	0.46	
cis-1,2-Dichloroethene	<		<	0.48		<	0.49		<	0.46	

E: Exceeds instrument calibration
J: Estimated Value
RL: Reporting Limit
NS: Not Sampled
NR: Not Reported
NA: Not Applicable
<: Not detected.

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB03-0 5			SB03-2			SB04-0.5			SB04-2			SB04-6			SB05-0.5			SB05-2		
Date sampled	10/12/1998			10/12/1998			10/19/1998			10/19/1998			10/19/1998			10/19/1998			10/19/1998		
Sample Number	MEBQC1			MEBQC2			MEBQE3			MEBQE4			MEBQE5			MEBQE1			MEBQE2		
Units	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
TOTAL METALS																					
Aluminum	4080			3960			3340			5130			3340			2580			3070		
Antimony	<	11.5	J	<	11.3	J	<	9.0		<	9.0		<	10.3		<	8.9		<	8.8	
Arsenic	1.6			1.3			1.00		J	1.1		J	0.60		J	1.2		J	0.60		J
Barium	27.9			21.9			21.2			39.5			18.7			44.7			34.5		
Beryllium	<	0.20		<	0.20		0.10		J	0.20		J	<	0.10		0.20		J	0.30		J
Cadmium	<	1.0		1.0			<	1.0		<	1.0		<	1.1		1.1			<	1.0	
Calcium	1670		J	480		J	1020			1530			2070			5460			4180		
Chromium	5.2		J	5.3		J	4.8			6.4			5.1			7.0			8.3		
Cobalt	<	3.4		<	3.4		<	1.7		<	1.7		<	1.9		3.2		J	3.1		J
Copper	15.9		J	4.3			3.8		J	3.3		J	3.1		J	16.4			17.1		
Iron	3450			2530			4120			5070			2570			4590			4360		
Lead	9.8			11.7			8.1		J	7.8		J	6.2		J	56.9			22.3		
Magnesium	697		J	333		J	724			833			346			2390			2050		
Manganese	58.7			14.8			69.9			86.2			58.1			109			66.4		
Mercury	<	0.06		<	0.06		0.05		J	0.05		J	<	0.06		0.08		J	0.06		J
Nickel	<	8.4		<	8.2		<	6.1		<	6.0		<	6.9		6.2		J	12.3		J
Potassium	253		J	<	127		<	198		288		J	<	227		<	195		419		J
Selenium	0.80		J	0.90		J	<	0.10		<	0.10		<	0.10		<	0.10		<	0.10	
Silver	<	0.90		<	0.90		<	1.1		<	1.1		<	1.3		<	1.1		<	1.1	
Sodium	20.4		J	39.0		J	34.5		J	525			110		J	50.2		J	50.6		J
Thallium	<	0.40		<	0.40		<	0.08		<	0.08		<	0.1		<	0.08		<	0.08	
Vanadium	7.8			5.7		J	7.0		J	9.4		J	3.7		J	8.3		J	9.2		J
Zinc	26.0			14.4			15.6			17.3			10.0			72.9			52.4		
Cyanide	0.05		J	0.2		J	<	0.10		0.10		J	0.20		J	0.30		J	0.20		J
VOLATILE ORGANICS																					
Sample Number	ECMK2			ECMK3			ECML6			ECML7			ECML8			ECML4			ECML5		
Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Methylene Chloride	34			<	18		<	11		<	11		<	13		<	11		<	10	
Acetone	2		J	2		J	<	11		<	11		<	13		<	11		<	10	
Carbon Disulfide	<	11		<	11		<	11		<	11		<	13		<	11		<	10	
1,1-Dichloroethane	<	11		<	11		<	11		<	11		<	13		<	11		<	10	
Benzene	<	11		<	11		<	11		<	11		<	13		<	11		<	10	
Ethylbenzene	<	11		<	11		<	11		<	11		<	13		<	11		<	10	
Xylene (total)	<	11		<	11		<	11		<	11		<	13		<	11		<	10	

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
***Himco Dump* Superfund Site**
Elkhart, Indiana

Sample location	SB03-0.5			SB03-2			SB04-0.5			SB04-2			SB04-6			SB05-0.5			SB05-2		
Date sampled	10/12/1998			10/12/1998			10/19/1998			10/19/1998			10/19/1998			10/19/1998			10/19/1998		
Sample Number	ECMK2			ECMK3			ECML6			ECML7			ECML8			ECML4			ECML5		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
SEMIVOLATILE ORGANICS																					
Units		µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg	
1,2-Dichlorobenzene	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
4-Methylphenol	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
Naphthalene	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
2-Methylnaphthalene	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
Acenaphthylene	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
Acenaphthene	<	360		<	360		<	350		<	350		<	420		<	350	J	<	340	
Dibenzofuran	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
Diethylphthalate	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
Fluorene	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
Phenanthrene	<	360		<	360		<	350		<	350		<	420		**46**		J	**140**		J
Anthracene	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
Carbazole	<	360	J	<	360	J	<	350		<	350		<	420		<	350		<	340	
Di-n-butylphthalate	<	360		<	360		<	350		<	350		<	420	J	<	350		<	340	
Fluoranthene	<	360		<	360		<	350		<	350		<	420		**130**		J	**210**		J
Pyrene	<	360		<	360		<	350		<	350		<	420		**140**		J	**210**		J
Butylbenzylphthalate	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
Benzo(a)anthracene	<	360		<	360		<	350		<	350		<	420		**75**	75	J	**120**		J
Chrysene	<	360		<	360		<	350		<	350		<	420		**84**	84	J	**110**		J
bis(2-Ethylhexyl)phthalate	**140**		J	<	360	J	<	350		<	350		<	420		<	350		**420**		
Di-n-octylphthalate	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
Benzo(b)fluoranthene	<	360		<	360		<	350		<	350		<	420		**110**		J	**140**		J
Benzo(k)fluoranthene	<	360		<	360		<	350		<	350		<	420		<	350		**38**		J
Benzo(a)pyrene	<	360		<	360		<	350		<	350		<	420		**89**	89	J	**110**		J
Indeno(1,2,3-cd)pyrene	<	360		<	360		<	350		<	350		<	420		**79**		J	**62**		J
Dibenz(a,h)anthracene	<	360		<	360		<	350		<	350		<	420		<	350		<	340	
Benzo(g,h,i)perylene	<	360		<	360		**61**		J	**50**		J	**74**		J	**110**		J	**78**		J

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB06-0.5			SB06-0.5 Dup			SB06-2			SB07-0.5			SB07-2			SB08-0.5			SB08-2		
Date sampled	10/19/1998			10/19/1998			10/19/1998			10/21/1998			10/21/1998			10/20/1998			10/20/1998		
Sample Number	MEBQE6			MEBQE7			MEBQF4			MEBQH6			MEBQH7			MEBQF5			MEBQF6		
Units	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
TOTAL METALS																					
Aluminum	4220			3000			2770			3100			1730			3150			1900		
Antimony	<	9.4		<	9.4		<	9.0		13.1		J	<	8.7	J	<	8.7		<	8.6	
Arsenic	2.1		J	1.4		J	1.1		J	2.3		J	0.70		J	1.1		J	0.55		J
Barium	51.8			47.7			40.4			13.0			7.8			14.8		J	126		
Beryllium	<	0.10		<	0.10		0.30		J	0.20		J	0.10		J	<	0.12		<	0.12	
Cadmium	<	1.0		<	1.0		<	1.0		<	1.0		<	0.90		<	0.95		<	0.94	
Calcium	1750			1660			728			1320			2140			953		J	<	6060	
Chromium	4.5			5.5			4.6			6.0			5.1			5.3			5.3		
Cobalt	3.3		J	1.9		J	2.8		J	4.0			1.9			3.3		J	1.9		J
Copper	20.4			19.9			22.6			7.4			6.4			5.3			5.1		J
Iron	6200			4800			3660			5240			4390			4680			2590		
Lead	13.4		J	17.2		J	9.4		J	5.2			6.5		S*	5.4			6.9		J
Magnesium	746			598			470			1140			1160			919		J	1040		
Manganese	337			296			227			133			44.7			105			35.8		
Mercury	<	0.06		<	0.06		<	0.05		<	0.05		<	0.05		0.05		J	<	0.05	
Nickel	9.6		J	7.0		J	<	6.0		6.0			<	5.8		<	5.9		6.7		J
Potassium	219		J	<	205		227		J	234			226			<	192		<	190	
Selenium	<	0.10		<	0.10		<	0.10		<	0.10	J	<	0.10	J	<	0.12		<	0.12	
Silver	<	1.2		<	1.2		<	1.1		<	1.1		<	1.1		<	1.1		<	1.1	
Sodium	24.8		J	<	18.1		32.6		J	41.6			<	16.8		29.9		J	32.7		J
Thallium	<	0.09		<	0.09		<	0.08		0.10		J	<	0.08	J	<	0.08		<	0.08	
Vanadium	8.5		J	7.0		J	5.2		J	8.1			4.7			10.0		J	5.7		J
Zinc	52.3			45.0			41.0			20.2			40.0			15.5			14.9		
Cyanide	0.30		J	<	0.10		<	0.10		0.20		J	<	0.10	J	0.92		J	0.40		J
VOLATILE ORGANICS																					
Sample Number	ECML9			ECMM6			ECMM7			ECMP9			ECMQ6			ECMM8			ECMM9		
Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Methylene Chloride	<	11		<	11		<	11		<	10		<	10		<	10		<	10	
Acetone	<	11		<	11		<	11		<	10		<	10		<	10		<	10	
Carbon Disulfide	<	11		<	11		<	11		<	10		<	10		<	10		<	10	
1,1-Dichloroethane	<	11		<	11		<	11		<	10		<	10		<	10		<	10	
Benzene	<	11		<	11		<	11		<	10		<	10		<	10		<	10	
Ethylbenzene	<	11		<	11		<	11		<	10		<	10		<	10		<	10	
Xylene (total)	<	11		<	11		<	11		<	10		<	10		<	10		<	10	

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB06-0.5			SB06-0.5 Dup			SB06-2			SB07-0.5			SB07-2			SB08-0.5			SB08-2		
Date sampled	10/19/1998			10/19/1998			10/19/1998			10/21/1998			10/21/1998			10/20/1998			10/20/1998		
Sample Number	ECML9			ECMM6			ECMM7			ECMP9			ECMQ6			ECMM8			ECMM9		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
SEMIVOLATILE ORGANICS																					
Units		µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg	
1,2-Dichlorobenzene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
4-Methylphenol	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Naphthalene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
2-Methylnaphthalene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Acenaphthylene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Acenaphthene	<	360		<	370		<	350		<	340	J	<	340		<	350		<	340	
Dibenzofuran	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Diethylphthalate	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Fluorene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Phenanthrene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Anthracene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Carbazole	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Di-n-butylphthalate	<	360	J	<	370	J	<	350	J	<	340	J	<	340	J	<	350		<	340	
Fluoranthene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Pyrene	<	360		<	370		<	350		<	340	J	<	340		<	350		<	340	
Butylbenzylphthalate	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Benzo(a)anthracene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Chrysene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
bis(2-Ethylhexyl)phthalate	<	360		<	370		**460**			**690**		J	**700**		J	<	360		<	1500	
Di-n-octylphthalate	<	360		<	370		<	350		<	340	J	<	340	J	<	350		<	340	
Benzo(b)fluoranthene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Benzo(k)fluoranthene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Benzo(a)pyrene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Indeno(1,2,3-cd)pyrene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Dibenz(a,h)anthracene	<	360		<	370		<	350		<	340		<	340		<	350		<	340	
Benzo(g,h,i)perylene	<	360		**250**		J	<	350		<	340		<	340		<	350		<	340	

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB09-0.5			SB09-0.5 Dup			SB09			SB10-0.5			SB10-0.5 Dup			SB10-2			SB10-6		
Date sampled	10/21/1998			10/21/1998			10/21/1998			10/20/1998			10/20/1998			10/20/1998			10/20/1998		
Sample Number	MEBQH3			MEBQH4			MEBQH5			MEBQF7			MEBQF8			MEBQF9			MEBQG0		
Units	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
TOTAL METALS																					
Aluminum	2480			2500			2120			4230			5670			3610			3320		
Antimony	<	9.0		<	8.9		<	8.8		<	9.1		<	9.2		<	8.9		<	9.0	
Arsenic	1.1		J	1.7		J	0.80		J	1.5		J	1.4		J	1.2		J	0.64		J
Barium	14.1		J	13.4		J	12.1		J	51.7			55.1			48.7			24.7		J
Beryllium	<	0.13		<	0.13		<	0.13		<	0.13		<	0.13		<	0.13		<	0.13	
Cadmium	<	0.98		<	0.97		<	0.96		<	0.99		1.2			<	0.97		<	0.99	
Calcium	19600			2650			12600			586		J	710		J	361		J	535		J
Chromium	5.7			5.4			5.2			5.5			7.0			5.5			7.6		
Cobalt	3.1		J	2.8		J	2.8		J	3.4		J	3.3		J	3.1		J	<	1.7	
Copper	9.2			9.1			8.0			35.1			37.2			38.1			12.7		
Iron	4750			4610			3620			4780			5330			4290			1330		
Lead	6.7			6.7			8.0			21.1		J	28.9		J	16.3		J	8.0		S
Magnesium	2380			1410			3500			559		J	766		J	503		J	678		J
Manganese	172			144			62.6			317			319			169			86.6		
Mercury	<	0.05		0.06		J	<	0.05		<	0.05		0.07		J	<	0.05		<	0.05	
Nickel	7.0		J	9.5			<	5.9		8.1		J	8.1		J	<	6.0		<	6.1	
Potassium	264		J	<	196		<	194		<	200		297		J	238		J	<	198	
Selenium	<	0.13		<	0.13	J	<	0.13	J	<	0.13		<	0.13		<	0.13		<	0.13	
Silver	<	1.1		<	1.1		<	1.1		<	1.1		<	1.1		<	1.1		<	1.1	
Sodium	36.2		J	37.6		J	32.6		J	34.3		J	45.5		J	39.3		J	29.6		J
Thallium	<	0.09		<	0.08		<	0.08		<	0.09		<	0.09		<	0.08		0.09		
Vanadium	7.2		J	8.8		J	7.8		J	10.1		J	10.4		J	9.5		J	<	10.9	
Zinc	26.2			22.2			24.1			58.3			68.9			50.1			24.9		
Cyanide	0.56		J	0.37		J	0.58		J	4.2			0.58		J	4.9			0.16		J
VOLATILE ORGANICS																					
Sample Number	ECMP6			ECMP7			ECMP8			ECMN0			ECMN1			ECMN2			ECMN3		
Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Methylene Chloride	<	11		<	10		<	10		<	11		<	11		<	10		<	11	
Acetone	<	11		<	10		<	10		<	11		<	11		<	10		<	11	
Carbon Disulfide	<	11		<	10		<	10		<	11		<	11		<	10		<	11	
1,1-Dichloroethane	<	11		<	10		<	10		<	11		<	11		<	10		<	11	
Benzene	<	11		<	10		<	10		<	11		<	11		<	10		<	11	
Ethylbenzene	<	11		<	10		<	10		<	11		<	11		<	10		<	11	
Xylene (total)	<	11		<	10		<	10		<	11		<	11		<	10		<	11	

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB09-0.5			SB09-0.5 Dup			SB09			SB10-0.5			SB10-0.5 Dup			SB10-2			SB10-6		
Date sampled	10/21/1998			10/21/1998			10/21/1998			10/20/1998			10/20/1998			10/20/1998			10/20/1998		
Sample Number	ECMP6			ECMP7			ECMP8			ECMN0			ECMN1			ECMN2			ECMN3		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
SEMIVOLATILE ORGANICS																					
Units		µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg	
1,2-Dichlorobenzene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
4-Methylphenol	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Naphthalene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
2-Methylnaphthalene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Acenaphthylene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Acenaphthene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Dibenzofuran	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Diethylphthalate	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Fluorene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Phenanthrene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Anthracene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Carbazole	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Di-n-butylphthalate	<	350	J	<	350	J	<	350	J	<	360		<	360		<	340		<	350	
Fluoranthene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Pyrene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Butylbenzylphthalate	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Benzo(a)anthracene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Chrysene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
bis(2-Ethylhexyl)phthalate	**440**		J	**470**		J	**2600**		J	**140**		J	**150**		J	**71**		J	<	350	
Di-n-octylphthalate	<	350	J	<	350	J	<	350	J	**56**		J	**70**		J	<	340		<	350	
Benzo(b)fluoranthene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Benzo(k)fluoranthene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Benzo(a)pyrene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Indeno(1,2,3-cd)pyrene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Dibenz(a,h)anthracene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	
Benzo(g,h,i)perylene	<	350		<	350		<	350		<	360		<	360		<	340		<	350	

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB11-0.5			SB11-2			SB11-6			SB12-0.5			SB12-2			SB12-6			SB13-0.5		
Date sampled	10/21/1998			10/21/1998			10/21/1998			10/20/1998			10/20/1998			10/20/1998			10/20/1998		
Sample Number	MEBQH0			MEBQH1			MEBQH2			MEBQG7			MEBQG8			MEBQG9			MEBQG4		
Units	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
TOTAL METALS																					
Aluminum	4740			3360			4270			2260			1360			2280			3900		
Antimony	<	8.9	J	9.2		J	<	8.8	J	<	8.8		<	8.7		<	8.8		<	9.4	
Arsenic	12.5		J	4.7		J	2.8		J	1.1		J	0.70		J	0.9		J	2.1		J
Barium	102			57.0			55.8			13.8		J	8.0		J	14.2		J	65.8		
Beryllium	0.50		J	0.20		J	0.20		J	0.25		J	<	0.12		<	0.13		0.30		J
Cadmium	1.1			<	1.0		<	1.0		<	0.96		<	0.95		<	0.96		1.2		
Calcium	21900			26400			7620			1060			2990			1510			9970		
Chromium	12.6			9.2			17.2			5.1			3.3			6.3			8.5		
Cobalt	3.2			3.4			6.8			2.8		J	3.5		J	3.4		J	3.2		J
Copper	149			46.1			45.9			6.2			4.6		J	12.5			18.9		
Iron	11100			8820			21200			4080			2470			4570			5970		
Lead	160		J	92.9		J	186		J	6.1		J	5.4			7.1		J	167		
Magnesium	5950			11400			2580			853		J	1920			1140			1550		
Manganese	492			278			398			128			47.4			52.9			326		
Mercury	0.20			0.20			0.20			<	0.05		<	0.05		<	0.05		0.10		J
Nickel	12.0			<	5.9		10.0			<	5.9		<	5.9		<	5.9		8.8		J
Potassium	462			287			377			<	193		<	192		<	194		423		J
Selenium	<	0.10	J	<	0.10	J	<	0.10	J	<	0.12		<	0.12		0.13			<	0.10	
Silver	<	1.1		<	1.1		<	1.1		<	1.1		<	1.1		<	1.1		<	1.2	
Sodium	127			54.7			49.1			38.2		J	30.5		J	61.5		J	48.6		J
Thallium	0.10			<	0.08		<	0.08		<	0.08		<	0.08		<	0.08		<	0.09	
Vanadium	11.3			8.9			11.3			6.5		J	5.6		J	9.2		J	8.5		J
Zinc	294			136			109			22.8			15.1			38.9			109		
Cyanide	0.40		J	<	0.10	J	0.30		J	0.17		J	0.18		J	0.25		J	0.50		J
VOLATILE ORGANICS																					
Sample Number	ECMP3			ECMP4			ECMP5			ECMP0			ECMP1			ECMP2			ECMN7		
Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Methylene Chloride	<	11		<	10		<	10		<	10		<	10		<	10		<	11	J
Acetone	<	11		<	10		<	10		<	10		<	10		<	10		<	11	J
Carbon Disulfide	<	11		<	10		<	10		<	10		<	10		<	10		<	11	J
1,1-Dichloroethane	<	11		<	10		<	10		<	10		<	10		<	10		<	11	J
Benzene	<	11		<	10		<	10		<	10		<	10		<	10		<	11	J
Ethylbenzene	<	11		<	10		<	10		<	10		<	10		<	10			11	R
Xylene (total)	<	11		<	10		<	10		<	10		<	10		<	10			11	R

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB11-0.5			SB11-2			SB11-6			SB12-0.5			SB12-2			SB12-6			SB13-0.5		
Date sampled	10/21/1998			10/21/1998			10/21/1998			10/20/1998			10/20/1998			10/20/1998			10/20/1998		
Sample Number	ECMP3			ECMP4			ECMP5			ECMP0			ECMP1			ECMP2			ECMN7		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
SEMIVOLATILE ORGANICS																					
Units		µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg	
1,2-Dichlorobenzene	<	360		<	340		<	340		<	350		<	340		<	690		<	370	
4-Methylphenol	<	360		<	340		<	340		<	350		<	340		<	690		<	370	
Naphthalene	<	360		<	340		<	340		<	350		<	340		<	690		<	370	
2-Methylnaphthalene	<	360		<	340		<	340		<	350		<	340		<	690		<	370	
Acenaphthylene	<	360		<	340		<	340		<	350		<	340		<	690		<	370	
Acenaphthene	<	360		**160**		J	<	340		<	350		<	340		<	690		<	370	
Dibenzofuran	<	360		**78**		J	<	340		<	350		<	340		<	690		<	370	
Diethylphthalate	<	360		<	340		<	340		<	350		<	340		<	690		<	370	
Fluorene	<	360		**160**		J	<	340		<	350		<	340		<	690		<	370	
Phenanthrene	<	200	J	**3300**			<	340		<	350		<	340		<	690		<	370	
Anthracene	<	360		**460**			<	340		<	350		<	340		<	690		<	370	
Carbazole	<	360		**210**		J	<	340		<	350		<	340		<	690		<	370	
Di-n-butylphthalate	<	360	J	<	340		<	340	J	<	350		<	340		<	690		<	370	
Fluoranthene	**400**			**4600**			**51**		J	<	350		<	340		<	690		**100**		J
Pyrene	**470**			**3800**			<	340		<	350		<	340		<	690		**110**		J
Butylbenzylphthalate	<	360		<	340		<	340		<	350		<	340		<	690		<	370	
Benzo(a)anthracene	**280**		J	**1500**			**42**		J	<	350		<	340		<	690		**64**		J
Chrysene	**320**		J	**1400**			**51**		J	<	350		<	340		<	690		**72**		J
bis(2-Ethylhexyl)phthalate	**42**		J	**74**		J	**39**		J	**440**			**290**		J	**3400**			**160**		J
Di-n-octylphthalate	<	360	J	<	340	J	<	340	J	<	350		<	340		<	690		<	370	
Benzo(b)fluoranthene	**580**			**1900**			**75**		J	<	350		<	340		<	690		**93**		J
Benzo(k)fluoranthene	**150**		J	**580**			<	340		<	350		<	340		<	690		**370**		
Benzo(a)pyrene	**430**			**1500**			**57**		J	<	350		<	340		<	690		**66**		J
Indeno(1,2,3-cd)pyrene	**540**			**490**			**48**		J	<	350		<	340		<	690		**57**		J
Dibenz(a,h)anthracene	**140**		J	**130**		J	<	340		<	350		<	340		<	690		**370**		
Benzo(g,h,i)perylene	**710**			**470**			**63**		J	<	350		<	340		<	690		**81**		J

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB13-2			SB13-6			SB14-0.5			SB14-2			SB14-6			SB15-0.5			SB15-2		
Date sampled	10/20/1998			10/20/1998			10/20/1998			10/20/1998			10/20/1998			10/19/1998			10/19/1998		
Sample Number	MEBQG5			MEBQG6																	
Units	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
TOTAL METALS																					
Aluminum	3980			3220			4120			4500			2630			3470			2860		
Antimony	<	9.2		<	9.1		<	11.2		<	8.8		<	9.5		<	9.8		<	9.1	
Arsenic	0.90		J	0.90		J	0.83		J	1.1		J	0.60		J	6.0		J	4.4		J
Barium	35.7			33.6			115			36.2		J	43.7		J	102			133		
Beryllium	0.20		J	0.30		J	0.33		J	<	71.3		<	0.14		0.60		J	0.50		J
Cadmium	1.3			<	1.0		<	1.2		<	106.4		<	1.0		1.1			1.2		
Calcium	9300			12000			32700			2840			9350			16400			26800		
Chromium	14.2			12.9			14.6			6.7			15.5			12.9			14.0		
Cobalt	3.9		J	3.3		J	4.3		J	3.0		J	3.0		J	5.1		J	5		J
Copper	14.4			17.0			2110			18.7			25.3			113			283		
Iron	9180			11300			9410			4680			3920			26000			19400		
Lead	58.7			45.6		J	191		J	19.6		J	127		J	695		J	287		
Magnesium	3060			3000			3880			1180			1650			4810			5420		
Manganese	203			220			539			170			184			514			399		
Mercury	0.08		J	0.10		J	0.25		J	0.06		J	0.11		J	0.40			0.50		
Nickel	12.0		J	15.4		J	8.0		J	<	5.9		9.8			21.0		J	23.7		J
Potassium	310		J	279		J	278		J	277		J	210		J	363		J	385		J
Selenium	<	0.10	J	0.10			<	0.16	J	<	0.13		<	0.14		<	0.10		<	0.10	
Silver	<	1.1		<	1.1		<	1.4		<	1.1		<	1.2		1.2			2.0		
Sodium	54.7		J	74.3		J	83.7		J	40.5		J	43.0		J	<	65.0	J	60.9		J
Thallium	<	0.09		<	0.09		<	0.11		<	0.08		<	0.09		0.10			<	0.08	
Vanadium	9.8		J	6.0		J	11.3		J	9.9		J	8.0		J	11.1		J	10.2		J
Zinc	175			90.9			161			49.8			249			427			465		
Cyanide	0.30		J	0.90		J	0.14		J	0.12		J	<	0.11		1.1		J	0.90		J
VOLATILE ORGANICS																					
Sample Number	ECMN8			ECMN9																	
Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Methylene Chloride	<	10		<	11		<	12		<	10		<	11		<	11		<	11	
Acetone	<	10		<	11		<	12		<	10		<	11		<	11		22		
Carbon Disulfide	<	10		<	11		<	12		<	10		<	11		<	11		<	11	
1,1-Dichloroethane	<	10		<	11		<	12		<	10		<	11		<	11		<	11	
Benzene	<	10		<	11		<	12		<	10		<	11		<	11		<	11	
Ethylbenzene	<	10		<	11		<	12		<	10		<	11		<	11		<	11	
Xylene (total)	<	10		<	11		<	12		<	10		<	11		<	11		<	11	

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB13-2			SB13-6			SB14-0.5			SB14-2			SB14-6			SB15-0.5			SB15-2		
Date sampled	10/20/1998			10/20/1998			10/20/1998			10/20/1998			10/20/1998			10/19/1998			10/19/1998		
Sample Number	ECMN8			ECMN9																	
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
SEMIVOLATILE ORGANICS																					
Units		µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg	
1,2-Dichlorobenzene	<	350		<	360		<	400		<	340		<	370		<	370		<	350	
4-Methylphenol	<	350		<	360		<	400		<	340		<	370		<	370		<	350	
Naphthalene	<	350		<	360		<	400		<	340		**120**		J	<	370		<	350	
2-Methylnaphthalene	<	350		<	360		<	400		<	340		<	370		<	370		<	350	
Acenaphthylene	<	350		<	360		<	400		<	340		<	370		<	370		<	350	
Acenaphthene	<	350		<	360		<	400		<	340		<	370		**73**		J	<	350	
Dibenzofuran	<	350		<	360		<	400		<	340		<	370		<	370		<	350	
Diethylphthalate	<	350		<	360		<	400		<	340		<	370		<	370		<	350	
Fluorene	<	350		<	360		<	400		<	340		<	370		<	370		<	350	
Phenanthrene	<	350		<	360		<	400		<	340		<	370		**360**		J	**280**		J
Anthracene	<	350		<	360		<	400		<	340		<	370		**63**		J	**53**		J
Carbazole	<	350		<	360		<	400		<	340		<	370		**37**		J	<	350	
Di-n-butylphthalate	<	350		<	360		<	400		<	340		<	370		<	370	J	<	350	J
Fluoranthene	<	350		**43**		J	**59**		J	<	340		**44**		J	**730**			**450**		
Pyrene	<	350		**44**		J	**64**		J	**40**		J		53	J	**900**			**540**		
Butylbenzylphthalate	<	350		<	360		**54**		J	<	340		<	370		<	370		<	350	
Benzo(a)anthracene	<	350		<	360		**41**		J	<	340		<	370		**620**			**260**		J
Chrysene	<	350		<	360		**59**		J	<	340		<	370		**760**			**270**		J
bis(2-Ethylhexyl)phthalate	**150**		J	**960**			**190**		J	**2900**			**30000**			<	370		<	350	
Di-n-octylphthalate	<	350		<	360		<	400		<	340		<	370		<	370		<	350	
Benzo(b)fluoranthene	<	350		**38**		J	**82**		J	<	340		**52**		J	**1600**			**390**		
Benzo(k)fluoranthene	<	350		<	360		**400**			<	340		<	370		**400**			**140**		J
Benzo(a)pyrene	<	350		<	360		**53**		J	<	340		<	370		**1000**			**290**		J
Indeno(1,2,3-cd)pyrene	<	350		<	360		**48**		J	<	340		<	370		**1200**			**230**		J
Dibenz(a,h)anthracene	<	350		<	360		**400**			<	340		<	370		**320**		J	**57**		J
Benzo(g,h,i)perylene	<	350		<	360		**86**		J	<	340		**38**		J	**1500**			**310**		J

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB15-6			SB16-05			SB16-2			SB16-6			SB16-6 Dup			SB17-0.5			SB17-2		
Date sampled	10/19/1998			10/15/1998			10/15/1998			10/15/1998			10/15/1998			10/15/1998			10/15/1998		
Sample Number																					
Units	mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
TOTAL METALS																					
Aluminum	8750			3340			4600			4820			8860			3230			5110		
Antimony	<	9.4		<	10.7	J	<	10.7	J	<	12.8	J	<	13.3	J	<	11.0	J	<	10.9	J
Arsenic	7.0		J	3.9			3.8			4.7			5.5			1.5			2.7		
Barium	112			32.5			55.5			54.3			95.7			29.7			37.4		
Beryllium	0.80		J	<	0.20		<	0.20		0.80		J	0.90		J	<	0.20		<	0.20	
Cadmium	2.0			<	0.90		<	0.90		<	1.10		<	1.10		1.0			<	0.90	
Calcium	31700			14000		J	14800		J	41200			85900		J	6220		J	<	18900	J
Chromium	17.9			7.9		J	9.6			13.1		J	11.3			6.3		J	9.5		
Cobalt	10.8			4.8		J	4.3		J	3.8		J	<	4.0		<	3.3		4.3		J
Copper	2220			16.4			49.0			18.3			18.9			63.9			11.9		
Iron	13500			8530			7460			10800			16600			3760			6680		
Lead	231		J	17.6			32.2			28.2			26.6			19.9			10.9		
Magnesium	22600			4860		J	3530		J	5460		J	7860		J	1440		J	4450		J
Manganese	1410			298			294			228			588			73.3			192		
Mercury	0.10		J	<	0.05		<	0.05		<	0.06		<	0.06		<	0.05		<	0.05	
Nickel	298			10.8			8.8			11.8			12.1			<	8.1		8.0		
Potassium	566		J	289		J	318		J	283		J	450		J	<	125		283		J
Selenium	<	0.10	J	0.60		J	0.70		J	1.4		J	1.3		J	0.80		J	0.80		J
Silver	<	1.2		<	0.80		<	0.80		<	1.0		<	1.1		<	0.90		<	0.90	
Sodium	184		J	29.8		J	78.0			219			378			27.4		J	65.4		
Thallium	<	0.09		<	0.40		0.50			0.50			<	0.50		<	0.40		<	0.40	
Vanadium	17.1			9.9			11.9			<	14.4		15.1			6.9			10.4		
Zinc	1120			66.5			109			78.0			78.6			54.0			26.6		
Cyanide	4.7			0.10		J	0.08		J	1.0			0.50			0.06		J	0.60		
VOLATILE ORGANICS																					
Sample Number																					
Units	µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg		
Methylene Chloride	<	10		<	18		<	24		<	13		<	25		<	20		<	10	
Acetone	<	10		2		J	<	10	J	<	12	J	<	14		3		J	<	10	J
Carbon Disulfide	<	10		<	11		<	10		<	12		2		J	<	11		<	10	
1,1-Dichloroethane	<	10		<	11		<	10		1		J	2		J	<	11		<	10	
Benzene	<	10		<	11		<	10		3		J	4		J	<	11		<	10	
Ethylbenzene	<	10		<	11		<	10		12			14			<	11		<	10	
Xylene (total)	<	10		<	11		<	10		7		J	9		J	<	11		<	10	

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location Date sampled Sample Number	SB15-6 10/19/1998			SB16-05 10/15/1998			SB16-2 10/15/1998			SB16-6 10/15/1998			SB16-6 Dup 10/15/1998			SB17-0.5 10/15/1998			SB17-2 10/15/1998		
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual
SEMIVOLATILE ORGANICS																					
Units		µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg	
1,2-Dichlorobenzene	<	330		<	350		<	350		98		J	63		J	<	360		<	350	
4-Methylphenol	<	330		<	350		<	350		<	410		<	390		<	360		<	350	
Naphthalene	38		J	<	350		<	350		120		J	130		J	<	360		<	350	
2-Methylnaphthalene	<	330		<	350		<	350		<	410		<	390		<	360		<	350	
Acenaphthylene	67		J	<	350		<	350		<	410		<	390		<	360		<	350	
Acenaphthene	<	330		<	350		<	350		<	410		<	390		<	360	J	<	350	
Dibenzofuran	<	330		<	350		<	350		<	410		<	390		<	360		<	350	
Diethylphthalate	<	330		<	350		<	350		64		J	46		J	<	360		<	350	
Fluorene	<	330		<	350		<	350		<	410		<	390		<	360		<	350	
Phenanthrene	170		J	37		J	100		J	270		J	250		J	380			83		J
Anthracene	41		J	<	350		<	350		53		J	57		J	59		J	<	350	
Carbazole	<	330		<	350		<	350		<	410		<	390		64		J	<	350	
Di-n-butylphthalate	<	330		<	350		<	350		<	410		390			<	360		<	350	
Fluoranthene	360			91		J	210		J	710			<	660		760			150		J
Pyrene	430			76		J	190		J	670			610			510		J	120		J
Butylbenzylphthalate	<	330		<	350	J	<	350	J	60		J	<	390	J	<	360	J	<	350	J
Benzo(a)anthracene	250		J	39		J	100		J	400		J	350		J	260		J	66		J
Chrysene	260		J	47		J	110		J	450			400			330		J	76		J
bis(2-Ethylhexyl)phthalate	<	330		410		J	160		J	270		J	120		J	51		J	36		J
Di-n-octylphthalate	<	330		<	350	J	<	350	J	<	410	J	<	390	J	<	360	J	<	350	J
Benzo(b)fluoranthene	490			44		J	120		J	750			430			280		J	55		J
Benzo(k)fluoranthene	140		J	50		J	120		J	900			440			340		J	77		J
Benzo(a)pyrene	430			53		J	120		J	530			450			280		J	62		J
Indeno(1,2,3-cd)pyrene	400			41		J	32		J	380		J	360		J	270		J	58		J
Dibenz(a,h)anthracene	99		J	350			43		J	160		J	150		J	120		J	350		
Benzo(g,h,i)perylene	550			39		J	89		J	280		J	250		J	220		J	47		J

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB18-0.5			SB18-2			SB18-6			SB19-0.5			SB19-2			SB19-6			SB20-0.5		
Date sampled	10/19/1998			10/19/1998			10/19/1998			10/15/1998			10/15/1998			10/15/1998			10/15/1998		
Sample Number																					
Units		mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg			mg/kg	
	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
TOTAL METALS																					
Aluminum	4320			6200			5540			4120			4090			5210			3950		
Antimony	<	9.5		<	9.2		<	10.6		<	11.2	J	<	11.4	J	<	13.8	J	<	11.1	J
Arsenic	1.5		J	4.8		J	3.4		J	3.4			6.1			4.6			5.8		
Barium	81.1			89.8			130			53.5			444			168			172		
Beryllium	0.40		J	0.20		J	0.30		J	<	0.20		<	0.20		<	0.20		<	0.20	
Cadmium	1.0			1.2			<	1.2		<	1.0		<	1.0		<	1.2		<	1.0	
Calcium	4230			13000			14300			5070		J	21700		J	70500		J	69200		J
Chromium	10.5			19.8			11.1			6.9		J	13.1			14.3			25.1		
Cobalt	4.5		J	5.9		J	5.7		J	5.0		J	4.9		J	5.4		J	4.9		J
Copper	41.7			25.6			36.0			50.6			113			48.8			242		
Iron	8960			15000			7950			6700			9130			11200			8700		
Lead	67.4			83.4			88.9			49.8			172			131			161		
Magnesium	1810			4440			3470			2050		J	5220		J	12600		J	9940		J
Manganese	474			513			312			373			286			250			592		
Mercury	0.30			0.10		J	0.09		J	0.06			0.20			0.10			27.9		
Nickel	<	6.4		15.0		J	9.4		J	13.5			14.7			11.3			<	16.5	
Potassium	539		J	210		J	328		J	210		J	370		J	586		J	404		J
Selenium	<	0.10		<	0.10		<	0.20		1.0		J	1.6		J	<	0.60		0.60		J
Silver	<	1.2		<	1.2		<	1.3		<	0.90		1.0			<	1.1		1.9		
Sodium	75.7		J	78.2		J	87.1		J	36.2		J	86.3			344			105		
Thallium	<	0.09		<	0.09		<	0.10		<	0.40		<	0.40		<	0.50		<	0.40	
Vanadium	11.2		J	18.0			16.1			<	10.1		12.7			12.7			12.8		
Zinc	103			160			182			81.6			434			307			324		
Cyanide	0.50		J	1.5		J	0.40		J	0.10		J	0.90			0.60			3.3		
VOLATILE ORGANICS																					
Sample Number																					
Units		µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg	
Methylene Chloride	<	11		<	11		<	11		<	19		75			57			<	13	
Acetone	<	11		<	11		<	11		2		J	4		J	7		J	<	11	J
Carbon Disulfide	<	11		<	11		<	11		<	11		<	11		<	15		<	11	
1,1-Dichloroethane	<	11		<	11		<	11		<	11		<	11		<	15		<	11	
Benzene	<	11		<	11		<	11		<	11		<	11		<	15		<	11	
Ethylbenzene	<	11		<	11		<	11		<	11		<	11		<	15		<	11	
Xylene (total)	<	11		<	11		<	11		<	11		<	11		<	15		<	11	

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB18-0 5			SB18-2			SB18-6			SB19-0 5			SB19-2			SB19-6			SB20-0.5		
Date sampled	10/19/1998			10/19/1998			10/19/1998			10/15/1998			10/15/1998			10/15/1998			10/15/1998		
Sample Number	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.	Result	RL	Qual.
SEMIVOLATILE ORGANICS																					
Units		µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg			µg/kg	
1,2-Dichlorobenzene	<	370		<	360		<	370		<	360		<	370		<	490		<	360	
4-Methylphenol	<	370		<	360		<	370		<	360		<	370		<	490		<	360	
Naphthalene	<	370		50		J	<	370		<	360		<	370		<	490		<	360	
2-Methylnaphthalene	<	370		48		J	<	370		<	360		<	370		<	490		<	360	
Acenaphthylene	<	370		83		J	<	370		96		J	290		J	<	490		<	360	
Acenaphthene	<	370		37		J	<	370		<	360		<	370		<	490		180		J
Dibenzofuran	<	370		<	360		<	370		<	360		<	370		<	490		<	360	
Diethylphthalate	<	370		<	360		<	370		<	360		<	370		<	490		<	360	
Fluorene	<	370		44		J	<	370		<	360		71		J	<	490		<	360	
Phenanthrene	320		J	590			86		J	160		J	450			190		J	460		
Anthracene	67		J	130		J	<	370		76		J	170		J	<	490		110		J
Carbazole	46		J	49		J	<	370		<	360		49		J	<	490		58		J
Di-n-butylphthalate	<	370		<	360		<	370		95		J	37		J	<	490		<	360	
Fluoranthene	510			1200			130		J	490			1700			490			1200		
Pyrene	470			1500			170		J	530			1900			420		J	1200		
Butylbenzylphthalate	<	370		<	360		<	370		<	360	J	<	370	J	<	490	J	<	360	J
Benzo(a)anthracene	<	270		770			77		J	310		J	1100			330		J	780		
Chrysene	<	270		780			100		J	300		J	970			380		J	880		
bis(2-Ethylhexyl)phthalate	<	370		<	360		<	370		73		J	160		J	170		J	90		J
Di-n-octylphthalate	<	370		<	360		<	370		<	360	J	<	370	J	130		J	120		J
Benzo(b)fluoranthene	410			1000			100		J	380			1700			690			1200		
Benzo(k)fluoranthene	89		J	340		J	370			360			2100			830			1200		
Benzo(a)pyrene	280		J	900			89		J	430			1400			480		J	1300		
Indeno(1,2,3-cd)pyrene	200		J	720			54		J	370			1100			410		J	1200		
Dibenz(a,h)anthracene	58		J	200		J	370			130		J	360		J	140		J	450		
Benzo(g,h,i)perylene	240		J	820			93		J	340		J	940			400		J	1000		

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location	SB20-2			SB20-6		
Date sampled	10/15/1998			10/16/1998		
Sample Number						
Units	mg/kg			mg/kg		
	Result	RL	Qual.	Result	RL	Qual.
TOTAL METALS						
Aluminum	4870			3420		
Antimony	<	11.1	J	<	10.9	J
Arsenic	10.8			8.1		
Barium	201			72.2		
Beryllium	<	0.70		0.7		J
Cadmium	1.1			<	0.9	
Calcium	24900		J	28700		J
Chromium	14.0			11.1		
Cobalt	5.4		J	6		J
Copper	664			54.4		
Iron	20600			11500		
Lead	238			105		
Magnesium	7730		J	8990		J
Manganese	454			200		
Mercury	4.5			1.2		
Nickel	22.3			11		
Potassium	483		J	339		J
Selenium	1.3		J	0.7		J
Silver	3.1			1.1		
Sodium	184			92.5		
Thallium	0.50			<	0.4	
Vanadium	15.8			12.9		
Zinc	537			121		
Cyanide	4.3			1.2		
VOLATILE ORGANICS						
Sample Number						
Units		µg/kg			µg/kg	
Methylene Chloride	<	17		<	11	
Acetone	2		J	2		J
Carbon Disulfide	<	11		<	11	
1,1-Dichloroethane	<	11		<	11	
Benzene	<	11		<	11	
Ethylbenzene	<	11		<	11	
Xylene (total)	<	11		<	11	

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 6-1
Soil Analytical Detections Summary - October 1998
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Sample location Date sampled Sample Number	SB20-2 10/15/1998			SB20-6 10/16/1998		
	Result	RL	Qual.	Result	RL	Qual.
SEMIVOLATILE ORGANICS						
Units		µg/kg			µg/kg	
1,2-Dichlorobenzene	<	360		<	350	
4-Methylphenol	50		J	<	350	
Naphthalene	290		J	2200		
2-Methylnaphthalene	160		J	1000		
Acenaphthylene	140		J	2300		
Acenaphthene	220		J	890		
Dibenzofuran	170		J	1500		
Diethylphthalate	<	360		<	350	
Fluorene	250		J	2500		
Phenanthrene	1900			18000		
Anthracene	450			4900		J
Carbazole	280		J	1500		
Di-n-butylphthalate	<	360		<	350	
Fluoranthene	2100			29000		
Pyrene	2500			21000		
Butylbenzylphthalate	<	360	J	<	350	J
Benzo(a)anthracene	1700			9700		
Chrysene	1400			9700		
bis(2-Ethylhexyl)phthalate	62		J	81		J
Di-n-octylphthalate	<	360		<	350	J
Benzo(b)fluoranthene	2800			9700		
Benzo(k)fluoranthene	1200			10000		
Benzo(a)pyrene	1700			11000		
Indeno(1,2,3-cd)pyrene	1200			6400		
Dibenz(a,h)anthracene	450			2000		
Benzo(g,h,i)perylene	1100			7100		

RL: Reporting Limit (For this data set the Reporting Limit is the Contract Required Quantitation Limit)
J: Estimated Value
R:Rejected Value (The data is unusable.)

Table 7-1
List of Contaminants by Media Type
Himco Dump Superfund Site
Elkhart, Indiana

Constituent	Leachate	Soils	Soil Gas	Ground Water
Metals and Cyanide				
Aluminum		X	na	
Antimony	X	X	na	
Arsenic	X	X	na	X
Beryllium	X	X	na	
Calcium	X	X	na	
Chromium	X	X	na	
Copper	X	X	na	X
Iron			na	X
Lead	X	X	na	X
Manganese		X	na	X
Magnesium	X	X	na	
Mercury	X	X	na	
Nickel	X	X	na	X
Sodium	X	X	na	X
Zinc	X	X	na	X
Thallium			na	X
Cyanide	X	X	na	
Organics				
Acetone	X	X		X
Benzene			X	X
Benzo(a)pyrene		X		
Benzo(a)anthracene		X		
Benzo(b)fluoranthene		X		
Benzo(k)fluoranthene		X		
Bis(2-ethylhexyl)phthalate	X			X
Bromodichloromethane				X
Butylbenzylpthalate				X
Carbazole				X
Chloroethane			X	X
Chloroform				X
Dibenz(a,h)anthracene		X		
1,4-Dichlorobenzene		X		
1,1-Dichloroethane			X	X
1,2-Dichloroethene			X	X
1,2-Dichloropropane				X
Diethyl phthalate				X
Ethylbenzene	X	X	X	
Fluoranthene		X		
2-Hexanone	X			
Indeno(1,2,3-cd)pyrene		X		
2-Methylphenol	X			
4-Methyl-2-Pentanone	X			X
4-Methylphenol	X	X		
Phenol	X			
Pyrene		X		
Tetrachloroethene			X	
Toluene		X	X	
1,1,1-Trichloroethane		X	X	X
Trichloroethene	X		X	X
Vinyl Chloride	X		X	X
Xylenes	X	X	X	

Notes:
-X denotes presence of contaminant above background or risk screening level.
-na denotes not analyzed

Table 7-2
Properties of Selected Chemicals Detected in the Soil and Ground Water at the Himco Dump Superfund Site [1]

Compound	Log K_{oc}	Log K_{ow} [2]	Vapor Pressure (mm) [3]	Henry's Constant (atm-m³/mol) [3]	Solubility in water (mg/L) [3]	Density mg/L at 20/4 °C [4]
Acetone	-0.43	-0.24	266 [d]	4.0 x 10^{-5} [d]	Totally Miscible	0.79
Benzene	1.89	2.00	95.2 [d]	5.5 x 10^{-3} [d]	1,800 [d]	0.88
Benzo(a)anthracene	6.14	5.81	1.1 x 10^{-7} [d]	8 x 10^{-6} [nt]	0.014 [d]	1.27
Benzo(a)pyrene	5.60-6.29	6.08	5.5 x 10^{-9} [d]	< 2.4 x 10^{-6} [nt]	4 x 10^{-3} [d]	1.35
Benzo(b)fluoranthene	5.74	6.57	5 x 10^{-7} [c]	1.2 x 10^{-5} [b,d]	0.012 [d]	NA
Benzo(k)fluoranthene	6.64	6.85	9.6 x 10^{-11} [d]	1.0 x 10^{-5} [nt]	5.5 x 10^{-4} [d]	NA
Bis(2-ethylhexyl)phthalate	4.20	5.0	6.2 x 10^{-8} [d]	1.1 x 10^{-5} [d]	0.04 [d]	0.98
Bromodichloromethane	1.79	1.88	50 [c]	2.1 x 10^{-3} [nt]	4,500 [a]	1.98
Butyl benzyl phthalate	1.83-2.54	4.63	8.6 x 10^{-6} [c]	1.3 x 10^{-6} [d]	2.82 [c]	1.12
Chloroethane	0.51	1.43	1,011 [c]	8.5 x 10^{-3} [d]	4,700 [d]	0.90
Chloroform	1.64	1.94	160 [c]	5.3 x 10^{-3} [c]	8,000 [c]	1.48
Dibenz(a,h)anthracene	6.22	6.28	≈ 10^{-10} [c]	7.3 x 10^{-9} [c,d]	5 x 10^{-4} [d]	1.28
1,4-Dichlorobenzene	2.20	3.46	0.4 [d]	4.4 x 10^{-3} [d]	79 [d]	1.25
1,1-Dichloroethane	1.48	1.78	234 [d]	5.9 x 10^{-3} [d]	5,060 [d]	1.18
1,2-Dichloroethene (*trans*)	1.77	2.09	265 [c]	6.7 x 10^{-3} [d]	6,300 [d]	1.26
1,2-Dichloropropane	1.57	2.28	50 [d]	2.9 x 10^{-3} [d]	2,800 [d]	1.56
Diethyl phthalate	1.84	2.29	0.05 [c]	8.5 x 10^{-7} [nt]	896 [d]	1.12
Ethylbenzene	2.19	3.11	7.08 [c]	8.7 x 10^{-3} [d]	206 [d]	0.87
Fluoranthene	4.62	5.22	5.0 x 10^{-6} [d]	0.017 [d]	0.265 [d]	1.25
2-Hexanone	2.13	1.38	3.8 [d]	1.7 x 10^{-3} [d]	35,000 [d]	0.81
Indeno(1,2,3-cd)pyrene	7.49	6.83	1.0 x 10^{-10} [d]	3.0 x 10^{-7} [d]	0.062 [nt]	NA
4-Methyl-2-Pentanone	0.79	1.09	15 [c]	1.5 x 10^{-5} [d]	17,000 [c]	0.80
2-Methylphenol	1.34	1.96	0.24 [d]	1.23 x 10^{-6} [d]	25,000 [d]	1.03
4-Methylphenol	1.69	2.13	0.13 [d]	7.9 x 10^{-7} [d]	23,000 [d]	1.02
Phenol	1.33	1.47	0.34 [d]	4.0 x 10^{-7} [d]	93,000 [d]	1.06
Pyrene	4.84	5.12	2.5 x 10^{-6} [d]	1.1 x 10^{-5} [nt]	0.132 [d]	1.27
Tetrachloroethene	2.43	2.53	20 [d]	0.015 [nt]	150 [d]	1.62
Toluene	2.12	2.57	22 [c]	6.7 x 10^{-3} [d]	535 [d]	0.87
1,1,1-Trichloroethane	2.10	2.36	124 [d]	0.016 [d]	950 [d]	1.34
Trichloroethene	1.98	2.72	57.8 [c]	9.9 x 10^{-3} [c]	1,100 [c]	1.46
Vinyl Chloride	0.39	0.60	2,660 [d]	0.056 [d]	1,100 [d]	0.91
Xylenes [5]	2.11-3.20	2.77-3.20	6.6 - 8.76 [d]	5.3 to 6.3 x 10^{-3} [d]	167-204 [d]	0.86-0.88

[1] All values taken from Montgomery and Welkom. 1990 or Montgomery. 1991.

[2] K_{oc} is the Organic Carbon/Soil Partition Coefficient and K_{ow} is the n-octanol/water partition coefficient. Both are unitless values. If more than one value is given in the reference, an average is provided in this table.

[3] Values of the properties vary with temperature. The value given in this table are determined for these temperatures: [a] = 0 °C, [b] = 10 °C, [c] = 20 °C, [d] = 25 °C, [e] = 70 °C, nt= no temperature provided: NA, not available

[4] Density is unitless and is the specific density of a substance at 20 °C with respect to water at 4 °C

[5] *o*-xylene, *m*-xylene, and *p*-xylene properties are combined.

Table 7-3
Total Organic Carbon Results from Remedial Investigation

Sample ID	Details	TOC (percent)
HD-GT01A-01	Soil Boring B-01, 0-2'	0.23
HD-GT02B-01	Soil Boring B-02, 2-4'	0.08
HD-GT03E-01	Soil Boring B-03, 8-10'	0.6
HD-GT05H-01	Soil Boring B-05, 14-16'	0.44
HD-GT06D-01	Soil Boring B-06, 6-8'	0.24
HD-GT11A-01	Soil Boring B-11, 0-2'	0.42
HD-GT11B-01	Soil Boring B-11, 5-7'	0.22
HD-GT11C-01	Soil Boring B-11, 10-12'	0.15
HD-HS01-01	0-18"; soils by landfill	1.05
HD-HS02-01	0-18"; soils by landfill	0.16
HD-HS03-01	0-18"; soils by landfill	0.56
HD-HS04-01	0-18"; soils by landfill	0.65
HD-HS05-01	0-18"; soils by landfill	0.68
HD-HS06-01	0-18"; soils by landfill	0.79
HD-HS07-01	0-18"; soils by landfill	8.9
HD-HS08-01	0-18"; soils by landfill	0.49
HD-HS09-01	0-18"; soils by landfill	1.02
HD-SB08-01	Soil Boring B-08, 63-63.5'	1.13
HD-SB08-02	Soil Boring B-08, 68-68.5'	0.6
HD-SB08-03	Soil Boring B-08, 73-73.5'	0.58
HD-SB08-04	Soil Boring B-08, 78-78.5'	0.69
HD-SB08-05	Soil Boring B-08, 83-83.5'	0.51
HD-SB09-01	Soil Boring B-09, 18-19'	0.67
HD-SB09-02	Soil Boring B-09, 23-23.5'	0.87
HD-SB09-03	Soil Boring B-09, 28-28.5'	0.54
HD-SB09-04	Soil Boring B-09, 33-33.5'	0.59
HD-SB09-05	Soil Boring B-09, 48-48.5'	0.5
HD-SB10-01	Soil Boring B-10, 18-18.5'	0.13
HD-SB10-02	Soil Boring B-10, 23-23.5'	0.52
HD-SB10-03	Soil Boring B-10, 28-28.5'	1.42
HD-SB10-04	Soil Boring B-10, 48-50'	1.39
HD-SB10-05	Soil Boring B-10, 53-54'	1.32
HD-SD13-01	0-18"; soils by landfill	0.66
HD-SD14-01	0-18"; soils by landfill	1.9
HD-SD15-01	0-18"; soils by landfill	0.23
HD-SD16-01	0-18"; soils by landfill	1.48
HD-SD17-01	Quarry Pond Sediment	1.86
HD-SD18-01	Quarry Pond Sediment	0.76
HD-SD19-01	Background Pond Sediment	1.35
HD-SD20-01	Background Pond Sediment	0.77
HD-SD21-01	Background Pond Sediment	1.76
HD-TL3DS1-01	Trench Sample, TL-3, 2 feet	3.97
HD-TL3DS2-01	Trench Sample, TL-3, 6 feet	7.63
HD-WS17-01	Wetland Soil Sample	1.21
HD-WS18-01	Wetland Soil Sample	0.11
HD-WS19-01	Wetland Soil Sample	0.7

TABLE 7-4
Table of Field Parameters Measured

Well	pH			SEC			ORP			DO		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
WTB1	8.30	7.50	7.73	704	626	670	49.0	-142.0	-16.3	7.3	0.1	3.7
WTB2	8.46	7.60	7.96	884	590	807	184.0	111.0	136.0	11.7	0.7	3.2
WTB3	8.50	7.40	7.70	684	373	518	55.0	-99.0	11.0	8.1	0.0	0.9
WTB4	7.59	7.54	7.57	508	193	378	5.0	-128.0	-61.5	6.2	0.1	2.2
WTE1	7.90	6.90	7.43	1081	737	1000	225.0	0.0	-3.5	3.0	0.0	0.7
WTE2	7.40	6.70	7.12	1700	192	522	256.0	256.0	256.0	1.7	0.1	1.0
WTE3	8.10	7.00	7.57	1130	440	801	214.0	-159.5	11.4	1.7	0.0	0.3
WTG1	7.90	7.40	7.64	631	410	484	63.0	-110.0	-31.0	1.6	0.0	0.5
WTG3	8.00	7.45	7.45	659	400	507	16.0	-95.0	-41.7	5.5	0.0	1.4
WTJ1	7.80	7.29	7.45	966	480	702	259.0	92.0	190.0	7.8	0.0	2.1
WTJ2	7.80	6.70	7.19	996	309	742	490.0	240.0	353.7	9.6	0.3	4.6
WTJ3	8.00	7.50	7.68	511	399	459	223.0	107.0	149.3	2.4	0.0	0.7
WTK1	8.00	7.10	7.69	703	356	480	66.0	22.0	44.0	6.0	0.0	1.4
WTK2	7.50	6.50	7.16	999	394	690	137.0	52.0	94.5	4.0	0.1	1.0
WTK3	8.10	6.90	7.78	542	381	437	50.0	40.0	45.0	4.0	0.0	0.9
WTM1	7.90	6.10	7.06	9220	380	2220	-47.0	-172.0	-117.3	3.7	0.0	0.8
WTM2	7.70	6.51	7.10	1210	862	1039	176.0	48.0	98.3	2.2	0.0	0.6
WTN1	7.70	6.80	7.38	1390	309	923	235.0	30.0	109.0	4.3	0.0	0.9
WTO1	7.90	7.40	7.65	727	478	600	223.0	105.0	159.3	5.0	0.2	1.1
WTP1	8.20	6.70	7.14	3100	308	1618	123.0	39.0	77.7	4.7	0.0	1.1
WT101A	7.35	6.59	6.91	3548	965	1796	-136.6	-136.6	-117.6	6.2	5.0	5.6
WT101B	8.48	7.04	7.59	1182	666	912	-296	-296	-296	7.0	4.1	5.6
WT101C	7.91	7.32	7.58	724	319	489	-193.2	-193.2	-193.2	2.5	1.4	1.9
WT102A	7.95	7.12	7.38	2196	724	1126	101.0	17.9	59.5	6.4	2.5	4.0
WT102B	7.71	7.47	7.58	501	407	453	11.0	11.0	11.0	0.3	0.0	0.1
WT102C	8.02	7.77	7.86	446	257	334	88.0	88.0	88.0	0.2	0.2	0.2
WT103A	8.05	7.62	7.84	626	536	581	ERR	ERR	0.0	2.7	2.7	2.7
WT104A	8.57	8.17	8.37	197	103	150	ERR	ERR	0.0	10.0	10.0	10.0
WT105A	8.13	7.32	7.82	446	201	290	-69.8	-69.8	-69.8	8.0	5.1	6.1
WT106A	7.21	6.84	7.07	1104	624	815	-109.5	-109.5	-109.5	6.4	1.2	3.0
WT111A	6.05	5.51	5.77	792	48	255	26.0	26.0	26.0	1.9	0.6	1.4
WT112A	7.57	7.42	7.49	1882	625	1108	119.0	100.1	109.6	4.9	3.8	4.3
WT112B	7.70	7.32	7.51	436	373	405	-37.0	-37.0	-37.0	0.3	0.0	0.1
WT113A	7.64	7.61	7.63	418	216	317	133.0	133.0	133.0	8.9	8.9	8.9
WT113B	7.46	7.17	7.32	602	408	505	2.0	2.0	2.0	0.3	0.0	0.2
WT114A	7.01	6.80	6.90	4021	1595	2525	-108.2	-122.7	-115.5	ERR	ERR	0.0
WT114B	7.10	7.07	7.09	857	729	793	-174.5	-174.5	-174.5	0.0	0.0	0.0
WT115A	6.83	6.62	6.74	3460	1382	2254	-41.8	-127.3	-84.6	3.3	0.0	1.2
WT116A	7.15	6.61	6.86	6744	3100	4217	-139.8	-175.8	-157.8	1.1	0.0	0.5
WT117A	7.52	7.38	7.45	290	289	290	51.0	51.0	51.0	3.1	0.9	2.0
WT117B	7.56	7.45	7.51	715	654	685	-115.0	-115.0	-115.0	0.2	0.0	0.1
WT118A	7.11	6.62	6.87	1780	973	1377	-84.0	-84.0	-84.0	0.3	0.0	0.1
WT119A	6.65	6.49	6.57	2246	1588	1917	-40.2	-60.7	-50.5	0.3	0.3	0.3

Notes: Max. = Maximum Min. = Minimum ERR = No values collected

Blue = Well Screened in Upper Aquifer

Red = Well Screened in Lower Aquifer

Table 9-1
Compounds Not Detected in Soils or Ground Water Samples with Detection Limits Greater Than RBSL's
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Matrix	Analysis/Compound	Maximum Detection Limit[a]	Human Health Risk-Based Screening Level[b]	Background[c]	QAPP Quantitation Limit[d]
Soils	**CLP SOW OLM03.1 TCL Semivolatile Organic Compounds, µg/kg**				
	bis(2-Chloroethyl)ether	690	180	NC	330
	N-Nitroso-di-n-propylamine	690	63	NC	330
	2-Nitroaniline	1700	330	NC	330
	Hexachlorobenzene	690	280	NC	330
Ground Water	**CLP SOW OLM03.1 TCL Volatile Organic Compounds, µg/L**				
	Bromomethane	1	0.87	NC	1
	1,1-Dichloroethene	1	0.046	NC	1
	Chloroform	1	0.16	NC	1
	1,2-Dichloroethane	1	0.12	NC	1
	Carbon Tetrachloride	1	0.17	NC	1
	Bromodichloromethane	1	0.18	NC	1
	cis-1,3-Dichloropropene	1	0.40	NC	1
	1,1,2-Trichloroethane	1	0.2	NC	1
	trans-1,3-Dichloropropene	1	0.40	NC	1
	1,1,2,2-Tetrachloroethane	1	0.055	NC	1
	CLP SOW OLM03.1 TCL Semivolatile Organic Compounds, µg/L				
	bis(2-Chloroethyl)ether	5	0.0098	NC	5
	2-Chlorophenol	5	3.8	NC	5
	1,3-Dichlorobenzene	5	1.7	NC	5
	1,4-Dichlorobenzene	5	0.047	NC	5
	2,2'-Oxybis(1-chloropropane)	5	0.27	NC	5
	N-Nitroso-di-n-propylamine	5	0.0096	NC	5
	Hexachlorobenzene	5	4.8	NC	5
	Nitrobenzene	5	0.34	NC	5
	Hexachlorobutadiene	5	0.86	NC	5
	2,4,6-Trichlorophenol	20	6.1	NC	20
	2-Nitroaniline	20	0.22	NC	20
	2,6-Dinitrotoluene	5	3.7	NC	5
	2,4-Dinitrophenol	20	7.3	NC	20
	4,6-Dinitro-2-methylphenol	5	0.37	NC	5
	Hexachlorobenzene	5	0.042	NC	5
	Pentachlorophenol	20	0.56	NC	20
	3-3'Dichlorobenzidine	5	0.15	NC	5
	Benzo(a)anthracene	5	0.092	NC	5
	Benzo(b)fluoranthene	5	0.092	NC	5
	Benzo(k)fluoranthene	5	0.92	NC	5
	Benzo(a)pyrene	5	0.0092	NC	5
	Indeno(1,2,3-cd)pyrene	5	0.092	NC	5
	Dibenz(a,h)anthracene	5	0.0092	NC	5

[a]*Maximum detection limit from the Himco Construction Debris Area soils, and ground water monitoring locations.*

[b]Soil Risk-Based Screening Levels (RBSLs) are EPA Region 9 residential soil Preliminary Remediation Goals (PRGs) (on-line), for carc compounds, and RBSLs divided by a factor of 10 for noncarc compounds. Likewise, ground water RBSLs are EPA Region 9 tap water PRGs (on-line), for carc compounds, and RBSLs divided by a factor of 10 for noncarc compounds.

[c]NC - *ground water; compound was not observed in the background samples, therefore no background mean or UTL* was calculated for the compound. Soils; not calculated.

[d]QAPP Quantitation Limit (USACE, 1998b)

Table 9-2
Occurrence, Distribution and Selection of COPC's
Mixed Soil Data
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Medium: Total Soil
Exposure Medium: Soil/Dust-Volatilization
Exposure Point: Ingestion/Dermal Contact/Inhalation

Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Quantitation Limits	Concentration Used for Screening (max)	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
Inorganics															
Aluminum	1360		8860		mg/kg	SB16-6	47/47	10.0	8860		7600 N			yes	ASL
Anitmony	9.2	J	13.1	J	mg/kg	SB07-0.5	2/47	8.6-13.8	13.1		3.1 N			yes	ASL
Arsenic	0.55	J	12.5	J	mg/kg	SB11-0.5	47/47	0.5	12.5		0.039 C			yes	ASL
Barium	7.8		444		mg/kg	SB19-2	47/47	1.0	444		540 N			no	BSL
Beryllium	0.10	J	0.9	J	mg/kg	SB16-6	23/47	0.10-0.70	0.9		15 N			no	BSL
Cadmium	1.0		2.0		mg/kg	SB15-6	13/47	0.90-1.2	2.0		3.7 N			no	BSL
Calcium	361	J	85900	J	mg/kg	SB16-6	47/47	20.0	85,900		4,000,000			no	NUT
Chromium	3.3		25.1		mg/kg	SB20-0.5	47/47	1.0	25.1		210 C			no	BSL
Cobalt	1.9	J	10.8		mg/kg	SB15-6	40/47	1.7-3.4	10.8		470 N			no	BSL
Copper	3.1	J	2,220		mg/kg	SB15-6	47/47	2.0	2,220		290 N			yes	ASL
Iron	1330		26,000		mg/kg	SB15-0.5	47/47	10.0	26,000		50,000			no	NUT
Lead	5.2		695	J	mg/kg	SB15-0.5	47/47	0.5	695		400			yes	ASL
Magnesium	333	J	22,600		mg/kg	SB15-6	47/47	20.0	22,600		85,000			no	NUT
Manganese	14.8		1,410		mg/kg	SB15-6	47/47	1.0	1,410		180 N			yes	ASL
Mercury	0.05	J	27.9		mg/kg	SB20-0.5	28/47	0.05-0.06	27.9		2.3 N			yes	ASL
Nickel	6.0		298		mg/kg	SB15-6	28/47	5.8-16.5	298		160 N			yes	ASL

(1) Minimum/maximum detected concentration from '98 Construction Debris Area soil data (all depths).

(2) '92 Himco Dump RI/FS background surface soil (0-2') data (Donohue, 1992) not used.

(3) Preliminary Remediation Goals Table, U.S. EPA Region 9, (Cancer benchmark value = 1E-06, HQ=0.1), or chemical-specific Recommended Daily Allowances (RDAs) or Daily Dietary Intakes.

(4) Rationale Codes

Selection Reason:
- Infrequent Detection but Associated Historically (HIST)
- Frequent Detection (FD)
- Toxicity Information Available (TX)
- Above Screening Levels (ASL)
- Quantitation Limit is greater than Risk-Based Screening Level (QL>RBSL)

Deletion Reason:
- Infrequent Detection (IFD)
- Background Levels (BKG)
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)

Definitions:
- N/A = Not Applicable
- SQL = Sample Quantitation Limit
- COPC = Chemical of Potential Concern
- ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
- ND = Not Detected
- MCL = Federal Maximum Contaminant Level
- SMCL = Secondary Maximum Contaminant Level
- J = Estimated Value
- C = Carcinogenic
- N = Non-Carcinogenic
- RBSL = Risk-Based Screening Level

Table 9-2
Occurrence, Distribution and Selection of COPC's
Mixed Soil Data
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Medium: Total Soil
Exposure Medium: Soil/Dust-Volatilization
Exposure Point: Ingestion/Dermal Contact/Inhalation

Chemical	(1) Minimum Concentration	Minimum Qualifier	(1) Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Quantitation Limits	Concentration Used for Screening (Max)	(2) Background Value	(3) Screening Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	(4) Rationale for Contaminant Deletion or Selection
Potassium	210	J	586	J	mg/kg	SB19-6	35/47	125-198	586		29,250,000			no	NUT
Selenium	0 6	J	1 6	J	mg/kg	SB19-2	12/47	0 10-0 60	1 6		39 N			no	BSL
Silver	1		3 1		mg/kg	SB20-2	6/47	0 80-1 40	3 1		39 N			no	BSL
Sodium	20 4	J	525		mg/kg	SB04-2	46/47	16 8	525		50,000,000			no	BSL
Thallium	0 1	J	0 5		mg/kg	multiple	6/47	0 08-0 40	0 5		0 51 N			no	BSL
Vanadium	3 7	J	18		mg/kg	SB18-2	47/47	1	18		55 N			no	BSL
Zinc	10		1120		mg/kg	SB15-6	47/47	2	1120		2300 N			no	BSL
Cyanide	0 05	J	4 9		mg/kg	SB10-2	42/47	0 10-0 11	4 9		120 N			no	BSL
Volatile Organics															
Methylene Chloride	0 034		0 075		mg/kg	SB19-2	3/47	0 010-0 024	0 075		8 9 C			no	BSL
Acetone	0 002	J	0 022		mg/kg	SB15-2	10/47	0 010-0 013	0 022		160 N			no	BSL
Carbon Disulfide	0 002	J	0 002	J	mg/kg	SB16-6	1/47	0 010-0 015	0 002		36 N			no	BSL
1,1-Dichloroethane	0 002	J	0 002	J	mg/kg	SB16-6	1/47	0 010-0 015	0 002		59 N			no	BSL
Benzene	0 004	J	0 004	J	mg/kg	SB16-6	1/47	0 010-0 015	0 004		0 67 C			no	BSL
Ethylbenzene	0 014		0 014		mg/kg	SB16-6	1/46	0 010-0 015	0 014		230 Sat			no	BSL
Xylene	0 009	J	0 009	J	mg/kg	SB16-6	1/46	0 010-0 015	0 009		210 Sat			no	BSL

(1) Minimum/maximum detected concentration from '98 Construction Debris Area soil data (all depths).
(2) '92 Himco Dump RI/FS background surface soil (0-2') data (Donohue, 1992) not used.
(3) Preliminary Remediation Goals Table, U S. EPA Region 9, (Cancer benchmark value = 1E-06, HQ=0.1), or chemical-specific Recommended Daily Allowances (RDAs) or Daily Dietary Intakes.
(4) Rationale Codes

Selection Reason:
- Infrequent Detection but Associated Historically (HIST)
- Frequent Detection (FD)
- Toxicity Information Available (TX)
- Above Screening Levels (ASL)
- Quantitation Limit is greater than Risk-Based Screening Level (QL>RBSL)

Deletion Reason:
- Infrequent Detection (IFD)
- Background Levels (BKG)
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)

Definitions:
- N/A = Not Applicable
- SQL = Sample Quantitation Limit
- COPC = Chemical of Potential Concern
- ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
- ND = Not Detected
- MCL = Federal Maximum Contaminant Level
- SMCL = Secondary Maximum Contaminant Level
- J = Estimated Value
- C = Carcinogenic
- N = Non-Carcinogenic
- Sat = Soil Saturation
- RBSL = Risk-Based Screening Level

Table 9-2
Occurrence, Distribution and Selection of COPC's
Mixed Soil Data
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Medium: Total Soil
Exposure Medium: Soil/Dust-Volatilization
Exposure Point: Ingestion/Dermal Contact/Inhalation

Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Quantitation Limits	Concentration Used for Screening (max)	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
Semivolatile Organics															
bis(2-Chloroethyl)ether	ND		ND		mg/kg		0/47	0.330-0.690	ND		0.21 C			yes	QL>RBSL
1,2-Dichlorobenzene	0.098	J	0.098	J	mg/kg	SB16-6	1/47	0.330-0.690	0.098		370 Sat			no	BSL
4-Methylphenol	0.050	J	0.050	J	mg/kg	SB20-2	1/47	0.330-0.690	0.050		31 N			no	BSL
N-Nitroso-di-n-propylamine	ND		ND		mg/kg		0/47	0.330-0.690	ND		0.069 C			yes	QL>RBSL
2-Nitrophenol	ND		ND		mg/kg		0/47	0.330-0.870	ND		none			no	NTX
bis(2-Chloroethoxy)methane	ND		ND		mg/kg		0/47	0.330-0.690	ND		none			no	NTX
Naphthalene	0.038	J	2.2		mg/kg	SB20-6	6/47	0.330-0.690	2.2		5.6 N			no	BSL
4-Chloro-3-methylphenol	ND		ND		mg/kg		0/47	0.330-0.690	ND		none			no	NTX
2-Methylnaphthalene	0.048	J	1.0		mg/kg	SB20-6	3/47	0.330-0.690	1.0		none			no	NTX
2-Nitroaniline	ND		ND		mg/kg		0/47	0.340-1.7	ND		0.35 N			yes	QL>RBSL
Acenaphthylene	0.067	J	2.3		mg/kg	SB20-6	6/47	0.330-0.690	2.3		none			no	NTX
3-Nitroaniline	ND		ND		mg/kg		0/47	0.390-1.7	ND		none			no	NTX
Acenaphthene	0.037	J	0.890		mg/kg	SB20-6	6/47	0.330-0.690	0.890		370 N			no	BSL
Dibenzofuran	0.078	J	1.5		mg/kg	SB20-6	3/47	0.330-0.690	1.5		29 N			no	BSL

(1) Minimum/maximum detected concentration from '98 Construction Debris Area soil data (all depths)
(2) '92 Himco Dump RI/FS background surface soil (0-2') data (Donohue, 1992) not used.
(3) Preliminary Remediation Goals Table, U.S. EPA Region 9, (Cancer benchmark value = 1E-06, HQ=0.1)
(4) Rationale Codes

Selection Reason:
- Infrequent Detection but Associated Historically (HIST)
- Frequent Detection (FD)
- Toxicity Information Available (TX)
- Above Screening Levels (ASL)
- Quantitation Limit is greater than Risk-Based Screening Level (QL>RBSL)

Deletion Reason:
- Infrequent Detection (IFD)
- Background Levels (BKG)
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)

Definitions:
- N/A = Not Applicable
- SQL = Sample Quantitation Limit
- COPC = Chemical of Potential Concern
- ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
- ND = Not Detected
- MCL = Federal Maximum Contaminant Level
- SMCL = Secondary Maximum Contaminant Level
- J = Estimated Value
- C = Carcinogenic
- N = Non-Carcinogenic
- Sat = Soil Saturation
- RBSL = Risk-Based Screening Level

Table 9-2
Occurrence, Distribution and Selection of COPC's
Mixed Soil Data
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Medium: Total Soil
Exposure Medium: Soil/Dust-Volatilization
Exposure Point: Ingestion/Dermal Contact/Inhalation

Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Quantitation Limits	Concentration Used for Screening (max)	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
Diethylphthalate	0 064	J	0.064	J	mg/kg	SB-16-6	1/47	0.330-0 690	0.064		4900 N			no	BSL
4-Chlorophenyl-phenylether	ND		ND		mg/kg		0/47	0 330-0 690	ND		none			no	NTX
Fluorene	0 044	J	2 5		mg/kg	SB20-6	5/47	0.330-0.690	2 5		260 N			no	BSL
4-Nitroaniline	ND		ND		mg/kg		0/47	0 830-1 7	ND		none			no	NTX
4,6-Dinitro-2-methylphenol	ND		ND		mg/kg		0/47	0 830-1 7	ND		none			no	NTX
4-Bromophenyl-phenylether	ND		ND		mg/kg		0/47	0 330-0 690	ND		none			no	NTX
Hexachlorobenzene	ND		ND		mg/kg		0/47	0 330-0 690	ND		0 30 C			yes	QL>RBSL
Phenanthrene	0 037	J	18 0		mg/kg	SB20-6	20/47	0 340-0 690	18 0		none			no	NTX
Anthracene	0 041	J	4 9	J	mg/kg	SB20-6	13/47	0 340-0 690	4 9		2200 C			no	BSL
Carbazole	0 037	J	1 5		mg/kg	SB20-6	9/47	0 330-0 690	1 5		24 C			no	BSL
Di-n-butylphthalate	0 037	J	0 095	J	mg/kg	SB19-0 5	3/47	0.330-0 690	0 095		610 N			no	BSL
Fluoranthene	0.043	J	29.0		mg/kg	SB20-6	26/47	0 350-0 690	29 0		230 N			no	BSL
Pyrene	0.040	J	21.0		mg/kg	SB20-6	26/47	0 340-0 690	21.0		230 N			no	BSL
Butylbenzylphthalate	0 054	J	0.06	J	mg/kg	SB16-6	2/47	0.330-0.690	0 06		1200 N			no	BSL
Benzo(a)anthracene	0.039	J	9 7		mg/kg	SB20-6	23/47	0 340-0 690	9 7		0 62 C			yes	ASL
Chrysene	0 047	J	9.7		mg/kg	SB20-6	23/47	0 340-0 690	9 7		62 C			no	BSL

(1) Minimum/maximum detected concentration from '98 Construction Debris Area soil data (all depths)
(2) '92 Himco Dump RI/FS background surface soil (0-2') data (Donohue, 1992) not used.
(3) Preliminary Remediation Goals Table, U.S. EPA Region 9, (Cancer benchmark value = 1E-06, HQ=0 1)
(4) Rationale Codes

Selection Reason:
- Infrequent Detection but Associated Historically (HIST)
- Frequent Detection (FD)
- Toxicity Information Available (TX)
- Above Screening Levels (ASL)
- Quantitation Limit is greater than Risk-Based Screening Level (QL>RBSL)

Deletion Reason:
- Infrequent Detection (IFD)
- Background Levels (BKG)
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)

Definitions:
- N/A = Not Applicable
- SQL = Sample Quantitation Limit
- COPC = Chemical of Potential Concern
- ARAR/TBC = Applicable or Relevant and Appropnate Requirement/To Be Considered
- ND = Not Detected
- MCL = Federal Maximum Contaminant Level
- SMCL = Secondary Maximum Contaminant Level
- J = Estimated Value
- C = Carcinogenic
- N = Non-Carcinogenic
- Sat = Soil Saturation
- RBSL = Risk-Based Screening Level

Table 9-2
Occurrence, Distribution and Selection of COPC's
Mixed Soil Data
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Medium: Total Soil
Exposure Medium: Soil/Dust-Volatilization
Exposure Point: Ingestion/Dermal Contact/Inhalation

Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Quantitation Limits	Concentration Used for Screening (max)	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
bis(2-Ethylhexyl)phthalate	0.036	J	30.0		mg/kg	SB14-6	32/47	0.330-1 5	30.0		35 C			no	BSL
Di-n-octylphthalate	0 056	J	0.130	J	mg/kg	SB19-6	3/47	0 330-0.690	0 130		120 N			no	BSL
Benzo(b)fluoranthene	0.038	J	9 7		mg/kg	SB20-6	26/47	0 340-0.690	9.7		0 062 C			yes	ASL
Benzo(k)fluoranthene	0.038	J	10.0		mg/kg	SB20-6	22/47	0 340-0 690	10.0		6.2 C			yes	ASL
Benzo(a)pyrene	0 053	J	11 0		mg/kg	SB20-6	24/47	0 340-0 690	11 0		0 062 C			yes	ASL
Indeno(1,2,3-c,d)pyrene	0.041	J	6.4		mg/kg	SB20-6	24/47	0.340-0.690	6.4		0 62 C			yes	ASL
Dibenz(a,h)anthracene	0 043	J	2.0		mg/kg	SB20-6	21/47	0 340-0 690	2 0		0.062 C			yes	ASL
Benzo(g,h,i)perylene	0 038	J	7 1		mg/kg	SB20-6	29/47	0 340-0 690	7 1		none			no	NTX

(1) Minimum/maximum detected concentration from '98 Construction Debris Area soil data (all depths).
(2) '92 Himco Dump RI/FS background surface soil (0-2') data (Donohue, 1992) not used.
(3) Preliminary Remediation Goals Table, U.S. EPA Region 9, (Cancer benchmark value = 1E-06, HQ=0 1).
(4) Rationale Codes

Selection Reason:
- Infrequent Detection but Associated Historically (HIST)
- Frequent Detection (FD)
- Toxicity Information Available (TX)
- Above Screening Levels (ASL)
- Quantitation Limit is greater than Risk-Based Screening Level (QL>RBSL)

Deletion Reason:
- Infrequent Detection (IFD)
- Background Levels (BKG)
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)

Definitions:
- N/A = Not Applicable
- SQL = Sample Quantitation Limit
- COPC = Chemical of Potential Concern
- ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
- ND = Not Detected
- MCL = Federal Maximum Contaminant Level
- SMCL = Secondary Maximum Contaminant Level
- J = Estimated Value
- C = Carcinogenic
- N = Non-Carcinogenic
- RBSL = Risk-Based Screening Level

Table 9-3
Occurrence, Distribution and Selection of COPC's
Combined Downgradient Ground Water Data Set for WT116A and WT119A
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Medium: Ground Water
Exposure Medium: Ground Water
Exposure Point: Tap Water/Water Vapor

Chemical	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Concentration Used for Screening (max)	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
Inorganics												
Aluminum	393		ug/L	WT116A-95	5/6	393	99.3	3700 N	50	SMCL	no	BSL
Antimony	20.4	J	ug/L	WT116A-95	1/6	20.4	12.4	1.5N	6	MCL	yes	ASL
Arsenic	6	J	ug/L	WT119A4-11/00	4/6	6	1.2	0.045 C	10	MCL	yes	ASL
Barium	192	J	ug/L	WT116A-95	6/6	192	41.3	260 N	2000	MCL	no	BSL
Beryllium	0.4		ug/L	WT116A-95	1/6	0.4	0.68	7.3 N	4	MCL	no	BKG/BSL
Cadmium	1.1		ug/L	WT116A04/00	1/6	1.1	1.5	1.8 N	5	MCL	no	BKG/BSL
Calcium	745,000		ug/L	WT116A11/00	6/6	745,000	132,016	400,000			yes	>NUT
Chromium	7.8		ug/L	WT119A-98	3/6	7.8	12.5	11 N	100	MCL	no	BKG/BSL
Cobalt	11.5	J	ug/L	WT116A-04/00	1/6	11.5	5.75	220 N			no	BSL
Copper	15.8		ug/L	WT116A-04/00	2/6	15.8	5.35	140N	1,000	SMCL	no	BSL
Iron	32,400		ug/L	WT116A-04/00	6/6	32,400	49.1	5000/11,000N	300	SMCL	yes	>NUT/ASL
Lead	13	JD	ug/L	WT116A-04/00	2/6	13	ND		15	AL	yes	ASL
Magnesium	70,800		ug/L	WT119A-04/00	6/6	70,800	16,250	75,000			no	< NUT
Manganese	1810	J	ug/L	WT116A-05/00	6/6	1810	31.6	88 N	50	MCL	yes	ASL
Mercury	0.1	J	ug/L	WT116A98	1/6	0.1	0.01	1.1 N	2	MCL	no	BSL
Nickel	13.3	J	ug/L	WT116A-05/00	2/6	28.3	31.9	73 N	100	MCL	no	BKG/BSL
Potassium	38,000		ug/L	WT116A-95	6/6	38,000	1795	900,000			no	< NUT
Selenium	6.0	J	ug/L	WT119A-98	1/6	13.3	ND	18N	50	MCL	no	BSL
Silver	2.5		ug/L	WT116A-95	1/6	6.0	6.8	18N	100	SMCL	no	BSL
Sodium	214,000		ug/L	WT116A-11/00	6/6	214,000	39,950	1,200,000			no	< NUT
Thallium	5.5	J	ug/L	WT116A-95	1/6	5.5	1.8	0.24 N	2	MCL	yes	ASL
Vanadium	11.5	J	ug/L	WT116A-95	1/6	11.5	9.9	26 N			no	BSL
Zinc	194	J	ug/L	WT116A-4/00	1/6	194	8.45	1100 N	5000	SMCL	no	BSL
Cyanide	31.9		ug/L	WT116A-98	2/4	31.9	8.5	73 N	200	MCL	no	BSL

(1) Maximum detected concentration from data set described in Section 9.2

(2) The arithmetic mean of upgradient well-pair WT102A/WT112A based on '95/'98/'00 combined ground water data. Constituents not detected were replaced by one-half the quantitation limit.

(3) Preliminary Remediation Goals Table, U.S. EPA Region 9, (Cancer benchmark value = 1E-06, HQ=0.1), or chemical-specific Recommended Daily Allowances (RDAs) or Daily Dietary Intakes.

(4) Rationale Codes

Above Screening Levels (ASL)

Background Levels (BKG)

Essential Nutrient (NUT)

Below Screening Level (BSL)

Definitions:

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

ND = Not Detected or Not Determined

MCL = Federal Maximum Contaminant Level

SMCL = Secondary Maximum Contaminant Level

AL = Action Level

J = Estimated Value

C = Carcinogenic

N = Non-Carcinogenic

Table 9-3
Occurrence, Distribution and Selection of COPC's
Combined Downgradient Ground Water Data Set for WT116A and WT119A
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Medium: Ground Water
Exposure Medium: Ground Water
Exposure Point: Tap Water/Water Vapor

Chemical	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Concentration Used for Screening (Max)	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
Volatile Organics												
ethyl ether	100		ug/L	WT116A-11/00	1/1	100	ND	none			no	NTX
Vinyl Chlonde	1		ug/L	WT116A-04/00	1/7	1	ND	0.04 C	2	MCL	yes	ASL
1,1-Dichloroethane	9.0		ug/L	WT116A11-2000	6/7	9.0	ND	81 N			no	BSL
total 1,2-Dichloroethene	1.0	J	ug/L	WT116A-95	2/4	1.0	ND	6.1 N			no	BSL
cis-1,2-dichloroethene	1.0		ug/L	WT116A-04/00	1/3	1.0	ND	6.1 N	70	MCL	no	BSL
1,2-Dichloropropane	4.0	J	ug/L	WT116A-95	4/7	4.0	ND	0.16 C	5	MCL	yes	ASL
Trichloroethene	0.9	J	ug/L	WT116A-95	2/7	0.9	ND	1.6 C	5	MCL	no	BSL
Benzene	15		ug/L	WT116A-95	3/7	15	ND	0.35 C	5	MCL	yes	ASL
Ethylbenzene	0.7	J	ug/L	WT116A-95	1/7	0.7	ND	130 N	700	MCL	no	BSL
dichlorofluoromethane	10		ug/L	WT116A-11/00	1/1	10	ND	none			no	NTX
Semivolatile Organics												
Naphthalene	0.4	J	ug/l	WT116A-95	1/6	0.4	ND	0.62 N			no	BSL
2-Methylnaphthalene	0.5	J	ug/L	WT116A-95	1/6	0.5	ND	none			no	NTX
Acenaphthene	3.0	J	ug/L	WT116A-95	1/6	3.0	ND	37 N			no	BSL
Dibenzofuran	2.0	J	ug/L	WT116A-95	1/6	2.0	ND	2.4 N			no	BSL
Diethylphthalate	4	J	ug/L	WT1116A-04/00	1/6	4	ND	2900 N			no	BSL
Fluorene	3.0	J	ug/L	WT116A-95	1/6	3.0	ND	24 N			no	BSL
Phenanthrene	0.2	J	ug/L	WT116A-95	1/6	0.2	ND	none	1	MCL	no	NTX
Anthracene	0.3	J	ug/L	WT116A-95	1/6	0.3	ND	180 N			no	BSL
Carbazole	6.0	J	ug/L	WT116A-98	1/6	6.0	ND	3.4 C			yes	ASL
bis(2-Ethylhexyl)phthalate	7.0		ug/L	WT116A-04/00	1/6	7.0	ND	4.8 C	6	MCL	yes	ASL
2-Hydroxybenzothiazole	23.0	J	ug/L	WT116A-11/00	1/1	23.0	ND	none			no	NTX

(1) Maximum detected concentration from data set described in Section 9.2

(2) The arithmetic mean of upgradient well-pair WT102A/WT112A based on '95/'98/'00 combined ground water data. Constituents not detected were replaced by one-half the quantitation limit

(3) Preliminary Remediation Goals Table, U.S. EPA Region 9, (Cancer benchmark value = 1E-06, HQ=0.1), or chemical-specific Recommended Daily Allowances (RDAs) or Daily Dietary Intakes

(4) Rationale Codes

Above Screening Levels (ASL)

Background Levels (BKG)

No Toxicity Information (NTX)

Essential Nutrient (NUT)

Below Screening Level (BSL)

Definitions:

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

ND = Not Detected or Not Determined

MCL = Federal Maximum Contaminant Level

SMCL = Secondary Maximum Contaminant Level

AL = Action Level

J = Estimated Value

C = Carcinogenic

N = Non-Carcinogenic

Table 9-4
Potentially Complete Human Health Exposure Pathways
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Current & Future Land Use	Surrounding Land Use	Potentially Contaminated Media	Potentially Exposed Populations	Exposure Route Evaluated Based on Available Data	Rationale
Residential	The Himco site is a closed landfill. Land use in the vicinity of site is agricultural, residential, and light industrial.	Surface Soil Subsurface Soil Ground Water Air[a]	Residents/CDA- adult and child Residents/East - adult and child - ground water only	ADULTS **Surface Soil** *Ingestion *Dermal Contact **Ground Water** *Ingestion *Dermal Contact (showering) * Inhalation (showering and household use) CHILDREN **Surface Soil** *Ingestion *Dermal Contact **Ground Water** *Ingestion *Dermal Contact (bathing) * Inhalation (bathing and household use) **Note:** Inhalation of soils/ dust not evaluated, inhalation of soils/ VOCs was to be considered only if "volatile" COPCs were identified.	The residential scenario is intended to address the event of a homeowner coming into contact with off-site surface soils (0 to 0.5 ft.) either by incidental ingestion or dermal contact. The COPC surface soil maximum concentration was used to obtain exposure point concentrations from each individual residence. For ground water, the residential scenario is intended to address the event of a homeowner installing a well and using the ground water underlying the site as a source of household water. The exposure point concentration was derived by using the maximum concentration from analytical data gathered from specific monitoring locations for proposed exposure areas.

Table 9-4
Potentially Complete Human Health Exposure Pathways
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Current & Future Land Use	Surrounding Land Use	Potentially Contaminated Media	Potentially Exposed Populations	Exposure Route Evaluated Based on Available Data	Rationale
Residential	The Himco site is a closed landfill. Land use in the vicinity of site is agricultural, residential, and light industrial.	Surface Soil Subsurface Soil Ground Water Air[a]	Residents/CDA involved in gardening/digging activities - adult and child	ADULTS **Mixed Soils 0-2 ft.** *Ingestion *Dermal Contact CHILDREN **Mixed Soils 0-2 ft.** *Ingestion *Dermal Contact **Note:** Neither receptor is expected to encounter ground water **Note:** Inhalation of soils/ dust not evaluated, inhalation of soils/ VOCs was to be considered only if "volatile" COPCs were identified.	The residential"gardening" scenario is intended to address the event of a homeowner coming into contact with off-site mixed soils to 2 ft. either by incidental ingestion or dermal contact while gardening or performing landscaping activities. The COPC maximum concentration using mixed soils data to 2 ft. was used to obtain exposure point concentrations from each individual residence.
			Construction Worker (involved in resident home improvement projects).	**Mixed Soils 0-6 ft.** *Ingestion *Dermal Contact *Inhalation **Note:** Not expected to encounter ground water **Note:** Inhalation of soils/ VOCs was to be considered only if "volatile" COPCs were identified.	Exposure to off-site related contaminants may occur during potential excavation activities. The COPC maximum concentration using mixed soils data to 6 ft. was used to obtain exposure point concentrations from each individual residence.

[a]The inhalation exposure route was quantified using modeling to address potential risk via the air pathway.

Table 9-5
Exposure Point Concentrations for COPC's in Himco CDA Soils
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

	Land Parcel M						Land Parcel O					
	0 - 0.5 ft.		0 - 2 ft.		0 - 6 ft.		0 - 0.5 ft.		0 - 2 ft.		0 - 6 ft.	
Chemical	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum
Aluminum	4080	detection	4080	detection	4080	detection	4220	detection	5130	detection	5130	detection
Antimony	5.75	non-detect	5.75	non-detect	5.75	non-detect	4.7	non-detect	4.7	non-detect	5.15	non-detect
Arsenic	1.6	detection	1.6	detection	1.6	detection	2.1J	detection	2.1J	detection	2.1J	detection
Copper	15.9J	detection	15.9J	detection	15.9 J	detection	20.4	detection	22.6	detection	22.6	detection
Manganese	58.7	detection	58.7	detection	58.7	detection	337	detection	337	detection	337	detection
Mercury	0.03	non-detect	0.03	non-detect	0.03	non-detect	0.08J	detection	0.08J	detection	0.08J	detection
Nickel	4.2	non-detect	4.2	non-detect	4.2	non-detect	9.6J	detection	12.3J	detection	12.3J	detection
Benzo(a)anthracene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.210	non-detect
Benzo(b)fluoranthene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.210	non-detect
Benzo(k)fluoranthene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.210	non-detect
Benzo(a)pyrene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.210	non-detect
Indeno(1,2,3-cd)pyrene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.210	non-detect
Dibenz(a,h)anthracene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.210	non-detect

[a]in mg/kg

Table 9-5
Exposure Point Concentrations for COPC's in Himco CDA Soils
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

	Land Parcel P						Land Parcel S					
	0 - 0.5 ft.		0 -2 ft.		0 - 6 ft.		0 - 0.5 ft.		0 - 2 ft.		0 - 6 ft.	
Chemical	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum
Aluminum	5670	detection	5670	detection	5670	detection	4740	detection	4740	detection	4740	detection
Antimony	4.6	non-detect	4.6	non-detect	4.6	non-detect	13.1J	detection	13.1J	detection	13.1J	detection
Arsenic	1.5J	detection	1.5J	detection	1.5J	detection	12.5J	detection	12.5J	detection	12.5J	detection
Copper	37.2	detection	38.1	detection	38.1	detection	2110	detection	2110	detection	2110	detection
Manganese	319	detection	319	detection	319	detection	539	detection	539	detection	539	detection
Mercury	0.07J	detection	0.07J	detection	0.07J	detection	0 25J	detection	0.25J	detection	0.25J	detection
Nickel	8.1J	detection	8.1J	detection	8.1J	detection	12	detection	12	detection	15.4J	detection
Benzo(a)anthracene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.280J	detection	1.5	detection	1.5	detection
Benzo(b)fluoranthene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.560	detection	1.9	detection	1.9	detection
Benzo(k)fluoranthene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.200	non-detect	0.560	detection	0.560	detection
Benzo(a)pyrene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.430	detection	1.5	detection	1.5	detection
Indeno(1,2,3-cd)pyrene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.540	detection	0.540	detection	0.540	detection
Dibenz(a,h)anthracene	0.180	non-detect	0.180	non-detect	0.180	non-detect	0.200	non-detect	0.200	non-detect	0.345	non-detect

[a]in mg/kg

Table 9-5
Exposure Point Concentrations for COPC's in Himco CDA Soils
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

	Land Parcel F						Land Parcel D					
	0 - 0.5 ft.		0 - 2 ft.		0 - 6 ft.		0 - 0.5 ft.		0 - 2 ft.		0 - 6 ft.	
Chemical	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum	EPC[a]	Selection Maximum
Aluminum	4320	detection	6200	detection	8860	detection	4120	detection	4120	detection	5210	detection
Antimony	5.55	non-detect	5.55	non-detect	6.65	non-detect	5.6	non-detect	5.7	non-detect	6.9	non-detect
Arsenic	6J	detection	10.8	detection	10.8	detection	3.4	detection	6.1	detection	6.1	detection
Copper	242	detection	664	detection	2220	detection	50.6	detection	113	detection	113	detection
Manganese	592	detection	592	detection	1410	detection	373	detection	373	detection	373	detection
Mercury	27.9	detection	27.9	detection	27.9	detection	0.06	detection	0.2	detection	0.2	detection
Nickel	21J	detection	23.7J	detection	298	detection	13.5	detection	14.7	detection	14.7	detection
Benzo(a)anthracene	0.780	detection	1.7	detection	9.7	detection	0.310J	detection	1.1	detection	1.1	detection
Benzo(b)fluoranthene	1.6	detection	2.8	detection	9.7	detection	0.380	detection	1.7	detection	1.7	detection
Benzo(k)fluoranthene	1.2	detection	1.2	detection	10	detection	0.360	detection	2.1	detection	2.1	detection
Benzo(a)pyrene	1.3	detection	1.7	detection	11	detection	0.430	detection	1.4	detection	1.4	detection
Indeno(1,2,3-cd)pyrene	1.2	detection	1.2	detection	6.4	detection	0.370	detection	1.1	detection	1.1	detection
Dibenz(a,h)anthracene	0.450	detection	0.450	detection	2	detection	0.130J	detection	0.360J	detection	0.360J	detection

[a]in mg/kg

Table 9-6
Exposure Point Concentrations for COPC's in Himco Downgradient Ground Water
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Chemical	Himco Downgradient Ground Water	
	Eastern Location EPC[a] in ug/L	WT116A/WT119A EPC[a] in ug/L
Antimony	--	20.4
Arsenic	24.3	6
Chromium	13.1	--
Iron	28,100	32,400
Manganese	3,080	1,810
Thallium	6.7	5.5
1,2-Dichloropropane	2	4
Benzene	3	15
Vinyl Chloride	--	1
Carbazole	--	6
bis(2-Ethylhexyl)phthalate	8	7

[a]The EPC for the Eastern Location is the maximum detected concentration of the analyte from the data set consisting of locations WT101A, WT114A, WT114B, GP16 (all depths), GP101 (all depths), and GP114 (all depths) for years 1990 through 2000. All useable data for these locations are highlighted in Table 2-1. The EPC for well pair WT116A/WT119A is the maximum detected concentration of the analyte from the well pair for years 1990 through 2000. All useable data for wells WT116A and WT119A are highlighted in Table 2-1.

Table 9-7
Variables Used to Estimate Potential Chemical Intakes and Contact Rates for Receptors from Soil
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Pathway Variable	Construction Worker	Gardener (age-adjusted)	Child Gardener	Resident (age-adjusted)	Child Resident
Inhalation of VOCs and Resuspended Dust from Soil					
IR_a (m^3/day)	20[a]	NA	NA	NA	NA
EF (days/year)	180[b]	NA	NA	NA	NA
ED (years)	0.75[b]	NA	NA	NA	NA
BW (kg)	70[a]	NA	NA	NA	NA
AT Non-cancer (days)[c]	266	NA	NA	NA	NA
AT Cancer (days)[d]	25550	NA	NA	NA	NA
Incidental Ingestion of Soil					
IR_s (mg/day)	480[e]	480[e]	200[a]	100[a]	200[a]
IFS_{adj} (mg-yrs/kg-day)	NA	245	NA	114	NA
FI_s (unitless)	1[b]	1[b]	1[b]	1[b]	1[b]
EF (days/year)	180[b]	40[e]	40[e]	350[a]	350[a]
ED (years)	0.75[b]	30[a]	6[a]	30[a]	6[a]
BW (kg)	70[a]	70[a]	15[a]	70[a]	15[a]
AT Non-cancer (days)[c]	266	NA	2190	NA	2190
AT Cancer (days)[d]	25550	25550	NA	25550	NA
Dermal Contact with Soil					
SA (cm^2)	2000[f]	5800[f]	1825[f]	5800[f]	1825[f]
SFS_{adj} (cm^2-yr/kg)	NA	2720	NA	2720	NA
EF (events/year)	180[b]	40[e]	40[e]	350[a]	350[a]
ED (years)	0.75[b]	30[a]	6[a]	30[a]	6[a]
BW (kg)	70[a]	70[a]	15[a]	70[a]	15[a]
AF (mg/cm^2-event)	1[f]	1[f]	1[f]	1[f]	1[f]
ABS (unitless)	csv	csv	csv	csv	csv
AT Non-cancer (days)[c]	266	NA	2190	NA	2190
AT Cancer (days)[d]	25550	25550	NA	25550	NA

Shaded variables were used to calculate the age-adjusted values.

NA=not applicable

csv=chemical-specific value

[a]EPA, 1991a

[b]Assumed (professional judgement); see Section 5.6.

[c]Calculated as the product of ED (years) x 365 days/year.

[d]Calculated as the product of 70 years (assumed human lifetime [EPA, 1989a]), x 365 days/year.

[e]EPA, 1997b

[f]EPA, 1992

Table 9-8
Variables Used to Estimate Potential Chemical Intakes
and Contact Rates for Receptors from Ground Water
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Pathway Variable	Construction Worker	Gardener (age-adjusted)	Child Gardener	Adult Resident/Resident (age-adjusted)	Child Resident
Inhalation of VOCs from Ground Water (shower/bath)					
$InhF_{adj}$ (m^3-year/kg-hr)	NA	NA	NA	0.22	NA
IR (m^3/hour)	NA	NA	NA	0.6[a]	0.6[a]
ET (hrs/day)	NA	NA	NA	0.2[a]	0.75[a]
EF (days/year)	NA	NA	NA	350[b]	350[b]
ED (years)	NA	NA	NA	30[b]	6[b]
BW (kg)	NA	NA	NA	70[b]	15[b]
AT Non-cancer (days)[c]	NA	NA	NA	NA	2190
AT Cancer (days)[d]	NA	NA	NA	25550	NA
f_s (unitless)	NA	NA	NA	0.75[a]	0.75[a]
F_{w-s}(L/hour)	NA	NA	NA	600[a]	600[a]
t (hour)	NA	NA	NA	0.31[a]	0.75[a]
V (m^3)	NA	NA	NA	9[a]	9[a]
Inhalation of VOCs from Ground Water (household use)					
$InhF_{adj}$ (m^3-year/kg-day)	NA	NA	NA	18.3	NA
IR_w (m^3/day)	NA	NA	NA	30[a]	20[a]
EF (days/year)	NA	NA	NA	350[b]	350[b]
ED (years)	NA	NA	NA	30[b]	6[b]
BW (kg)	NA	NA	NA	70[b]	15[b]
AT Non-cancer (days)[c]	NA	NA	NA	NA	2190
AT Cancer (days)[d]	NA	NA	NA	25550	NA
f_h (unitless)	NA	NA	NA	0.5[a]	0.5[a]
F_{w-h} (L/day)	NA	NA	NA	723[a]	723[a]
HV (m^3)	NA	NA	NA	177.7[a]	177.7[a]
k (unitless)	NA	NA	NA	0.15[a]	0.15[a]
ER (exchanges/day)	NA	NA	NA	13.7[a]	13.7[a]
Ingestion of Drinking Water					
IFW_{adj} (L-year/kg-day)	NA	NA	NA	1.09	NA
IR (L-day)	NA	NA	NA	2[a]	1[a]
EF (days/year)	NA	NA	NA	350[b]	350[b]
ED (years)	NA	NA	NA	30[b]	6[b]
BW (kg)	NA	NA	NA	70[b]	15[b]
AT Non-cancer (days)[c]	NA	NA	NA	NA	2190
AT Cancer (days)[d]	NA	NA	NA	25550	NA
Dermal Contact with Ground Water					
$SFW_{adj\ inorganics}$(cm^2-year/kg)	NA	NA	NA	3561	NA
SA (cm^2)	NA	NA	NA	20000[f]	7300[f]
ET_d (hours/event)	NA	NA	NA	0.2[a]	0.75[a]
EF (events/year)	NA	NA	NA	350[b]	350[b]
ED (years)[g]	NA	NA	NA	30[b]	6[b]
BW (kg)	NA	NA	NA	70[b]	15[b]
Kp (cm/hour)	NA	NA	NA	csv	csv
AT Non-cancer (days)[c]	NA	NA	NA	NA	2190
AT Cancer (days)[d]	NA	NA	NA	25550	NA

Shaded variables were used to calculate the age-adjusted values. The variable t (hour); inhalation of VOCs (shower/bath), is an adjusted exposure time to account for the different adult and child exposure times (ET) (cancer evaluation).

NA=not applicable

csv=chemical-specific value

[a]1997 Exposure Factors Handbook (EPA/600/P-95/002Fa) (USEPA, 1997b) was used for exposure time.

[b]EPA, 1991a

[c]Calculated as the product of ED (years) x 365 days/year.

[d]Calculated as the product of 70 years (assumed human lifetime [EPA, 1989a]), x 365 days/year.

[e]RISK*ASSISTANT software. Thistle Publishing.

[f]EPA, 1992

[g]An exposure duration of 24 years was used in calculation of the adult resident exposure.

Table 9-9
Chemical-Specific Values for Detected Chemicals of Potential Concern
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

COPC	Reference Dose - RfD[a] (mg/kg-day) Oral	Inh.	Dermal	Cancer Slope Factor -CSF[a] (mg/kg-day)$^{-1}$ Oral	Inh.	Dermal	ABS[b]	GAF	(source)	Kp[c] (cm/hr)	B[d]	tau[e] (hr)	t*[f] (hr)	VF/PEF[g] (m^3/kg)
Metals														
Aluminum	1.00E+00	1.00E-03	2.70E-01				0.01	0.27	ATSDR '92	0.001				h
Antimony	4.00E-04		6.00E-05				0.01	0.15	I	0.001				h
Arsenic[i]	3.00E-04		3.00E-04	1.50E+00	1.51E+01	1.50E+00	0.03	0.95	I	0.001				h
Chromium	3.00E-03		3.00E-05					0.01	ATSDR '93	0.001				NA
Copper	4.00E-02		4.00E-02				0.01	0.6	NCEA 6-24-92	0.001				h
Iron	3.00E-01		1.50E-02				0.01	0.05	EPA 1989	0.001				NA
Manganese-nonfood	4.70E-02	1.43E-05	1.88E-03				0.01	0.04	I	0.001				h
Mercury	3.00E-04	8.60E-05	2.10E-05				0.01	0.07	I	0.001				h
Nickel	2.00E-02		8.00E-04				0.01	0.04	I	0.001				h
Thallium (sulfate)	8.00E-05		8.00E-05				0.01	1	I	0.001				NA
Volatile/Semivolatile Organics														
Benzene[j]	3.00E-03	1.70E-03	3.00E-03	5.50E-02	2.70E-02	5.50E-02	0.10	1	IRIS	2.00E-02	1.30E-02	2.60E-01	6.30E-01	2.80E+03
Dichloropropane,1,2-		1.14E-03		6.80E-02		6.80E-02	0.10	0.9	I	1.00E-02	1.00E-02	4.30E-01	1.00E+00	3.70E+03
Vinyl Chloride	3.00E-03	2.86E-02	3.00E-03	1.40E+00	3.10E-02	1.40E+00	0.10	1	IRIS	7.30E-03	2.30E-03	2.10E-01	5.10E-01	1.00E+03
Benzo(a)anthracene				7.30E-01		7.30E-01	0.13	0.74	I					h
Benzo(a)pyrene[k]				7.30E+00		7.30E+00	0.13	0.74	I					h
Benzo(b)fluoranthene				7.30E-01		7.30E-01	0.13	0.74	I					h
benzo(k)fluoranthene				7.30E-02		7.30E-02	0.13	0.74	I					h
Bis(2-ethylhexyl)phthalate	2.00E-02		2.00E-02	1.40E-02	1.40E-02	1.40E-02	0.10	0.9	Jones/Owen '89	3.30E-02		2.10E+01	1.00E+02	NA
Carbazole				2.00E-02		2.00E-02	0.10	0.9	Jones/Owen '89	6.55E-02		9.20E-01	5.50E+00	NA
Dibenz(a,h)anthracene				7.30E+00		7.30E+00	0.13	0.74	I					h
Indeno(1,2,3-c,d)pyrene				7.30E-01		7.30E-01	0.13	0.74	I					h

[a]Values are from either IRIS 2002, HEAST 1997, or NCEA values

[b]EPA 1992 Dermal Exposure Assessment Principles and Applications. In general, the ABS for inorganics is 1% and organics is 10%; exceptions are noted.

[c]EPA 1992 Dermal Exposure Assessment Principles and Applications

[d]EPA 1992 Dermal Exposure Assessment Principles and Applications

[e]EPA 1992 Dermal Exposure Assessment Principles and Applications

[f]EPA 1992 Dermal Exposure Assessment Principles and Applications

[g]VF/PEF values are from EPA Region 9 PRG Table

[h]The construction worker scenario uses the PEF value 1.42E+09

[i]ABS from Wester, R.C., H.I. Maibach, et al., 1993.

[j]IRIS now presents a range of slope factors for benzene. The lowest values are presented here because "any value (within the range) will have equal scientific plausibility (EPA 2000b)."

[k]Benzo(a)anthracene, benzo(b)fluoranthene, and benzo(k)fluoranthene toxicity values based on their relative potency with respect to benzo(a)pyrene (EPA, 1993)

[l]Verbal communication [2/27/01 - EPA Region 5 (Pat VanLeeuwen)]

ABS = Absorption Factor (dermal)
COPC = Chemical of Potential Concern
GAF = Gastrointestinal absorption factor
NA = Not Applicable
source acronyms:
I = IRIS =Integrated Risk Information System, 2002
N = NCEA = National Center for Environmental Assessment
H = HEAST = Health Effects Assessment Summary Tables, 1997
ATSDR = Agency for Toxic Substances and Disease Registry

Kp = Permeability coefficient
B = flux through the skin (dimensionless)
t* =time to reach steady state absorption
VF/PEF = Volatilization factor/particulate emission factor
Blank space = Indicates no published value available

Table 9-10
Summary of Receptor Risks and Hazards for COPC's
Downgradient Ground Water
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	*Current/Future*
Receptor Population:	Resident
Receptor Age:	Age-Adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Ground water	Ground water	Downgradient Ground Water - Tap Water	Antimony										
			Arsenic	1.3E-04		4.4E-07	1.3E-04						
			Iron										
			Manganese										
			Thallium										
			Bis(2-ethylhexyl)phthalate	1.5E-06		3.1E-06	4.6E-06						
			Carbazole	1.8E-06		1.6E-06	3.4E-06						
			Benzene	1.2E-05		2.0E-06	1.4E-05						
			1,2-Dichloropropane	4.1E-06		3.8E-07	4.4E-06						
			Vinyl Chloride	2.1E-05		1.1E-06	2.2E-05						
			Exposure Point Total	1.7E-04		8.6E-06	1.8E-04						
	Air	Water Vapors from Showerhead	Benzene		9.5E-06		9.5E-06						
			1,2-Dichloropropane										
			Vinyl Chloride		7.2E-07		7.2E-07						
			Exposure Point Total		1.0E-05		1.0E-05						
		Water Vapors from Household Use	Benzene		1.0E-04		1.0E-04						
			1,2-Dichloropropane										
			Vinyl Chloride		7.7E-06		7.7E-06						
			Exposure Point Total		1.1E-04		1.1E-04						
						Total Risk Across Groundwater	3.0E-04					Total Hazard Index Across Groundwater	

Table 9-10
Summary of Receptor Risks and Hazards for COPC's
Downgradient Ground Water
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Ground water	Ground water	Downgradient Ground Water - Tap Water	Antimony					Antimony	blood	3.3		1.2E-01	3.4
			Arsenic					Arsenic	skin	1.3		7.0E-03	1.3
			Iron					Iron	liver	6.9		7.6E-01	7.7
			Manganese					Manganese	CNS	5.8		3.4E-01	6.1
			Thallium					Thallium	blood/hair loss	4.4		2.4E-02	4.4
			Bis(2-ethylhexyl)phthalate					Bis(2-ethylhexyl)phthalate		2.2E-02		5.9E-02	8.1E-02
			Carbazole					Carbazole					
			Benzene					Benzene		3.2E-01		5.9E-02	3.8E-01
			1,2-Dichloropropane					1,2-Dichloropropane					
			Vinyl Chloride					Vinyl Chloride		2.1E-02		2.8E-06	2.1E-02
			Exposure Point Total							22		1.4	23
	Air	Bathing - Represented by water vapors from showerhead	Benzene					Benzene	blood		4.8		4.8
			1,2-Dichloropropane					1,2-Dichloropropane	respiratory		1.9		1.9
			Vinyl Chloride					Vinyl Chloride			1.9E-02		1.9E-02
			Exposure Point Total								6.7		6.7
		Household Use	Benzene					Benzene	blood		11		11
			1,2-Dichloropropane					1,2-Dichloropropane	respiratory		4.4		4.4
			Vinyl Chloride					Vinyl Chloride			4.4E-02		4.4E-02
			Exposure Point Total								16		16
							Total Risk Across Ground water						Total Hazard Index Across Ground water: 46

Total [blood] HI =	12.5
Total [skin] HI =	1.3
Total [liver] HI =	6.9
Total CNS] HI =	5.8
Total [respiratory] HI =	6.3

Table 9-11
Summary of Receptor Risks and Hazards for COPC's
Parcel M
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-6 ft)	Soil (0-6 ft)	Parcel M Soil (0-6 ft)	Aluminum					Aluminum		1 4E-02		2 2E-03	1 6E-02
			Antimony					Antimony		5 0E-02		1 4E-02	6 4E-02
			Arsenic	8 7E-06		1 1E-08	9 8E-08	Arsenic		1 9E-02		2 3E-03	2 1E-02
			Copper					Copper		1 4E-03		5 8E-05	1 4E-03
			Manganese					Manganese		4 3E-03		4 5E-03	8 9E-03
			Mercury					Mercury		3 5E-04		2 1E-04	5 6E-04
			Nickel					Nickel		7 3E-04		7 6E-04	1 5E-03
			Benzo(a)anthracene	4 8E-09		2 6E-09	7 3E-09	Benzo(a)anthracene					
			Benzo(b)fluoranthene	4 8E-09		2 6E-09	7 3E-09	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	4 8E-10		2 6E-10	7 3E-10	Benzo(k)fluoranthene					
			Benzo(a)pyrene	4 8E-08		2 6E-08	7 3E-08	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	4 8E-09		2 6E-09	7 3E-09	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	4 8E-08		2 6E-08	7 3E-08	Dibenz(a,h)anthracene					
			Chemical Total	2 0E-07		7 0E-08	2 7E-07	Chemical Total		0 09		0 02	0 11
	Particulates	Parcel M Particulates from Soil (0-6 ft)	Aluminum					Aluminum			4 2E-04		4 2E-04
			Antimony					Antimony					
			Arsenic		2 6E-11		2 6E-11	Arsenic					
			Copper					Copper					
			Manganese					Manganese			4 2E-04		4 2E-04
			Mercury					Mercury			3 6E-08		3 6E-08
			Nickel					Nickel					
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total		2 6E-11		2 6E-11	Chemical Total			8 4E-04		8 4E-04
						Total Risk Across Soil	2 7E-07					Total Hazard Index Across Soil	0 11
						Total Risk Across All Media and All Exposure Routes	2 7E-07					Total Hazard Index Across All Media and All Exposure Routes	0 11

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-11
Summary of Receptor Risks and Hazards for COPC's
Parcel M
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Age-adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel M Surface Soil (0-0.5 ft.)	Antimony					Antimony					
			Arsenic	3.7E-06		2.7E-06	6.4E-06	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Benzo(a)anthracene	2.1E-07		6.4E-07	8.4E-07	Benzo(a)anthracene					
			Benzo(b)fluoranthene	2.1E-07		6.4E-07	8.4E-07	Benzo(b)fluoranthene					
			Benzo(a)pyrene	2.1E-06		6.4E-06	8.4E-06	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	2.1E-07		6.4E-07	8.4E-07	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	2.1E-06		6.4E-06	8.4E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	8.5E-06		1.7E-05	2.6E-05	Exposure Point Total					
Soil (0-2 ft.)	Soil (0-2 ft.)	Parcel M Gardening Soil (0-2 ft)	Aluminum					Aluminum					
			Antimony					Antimony					
			Arsenic	9.2E-07		3.1E-07	1.2E-06	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Nickel					Nickel					
			Benzo(a)anthracene	5.0E-08		7.3E-08	1.2E-07	Benzo(a)anthracene					
			Benzo(b)fluoranthene	5.0E-08		7.3E-08	1.2E-07	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	5.0E-09		7.3E-09	1.2E-08	Benzo(k)fluoranthene					
			Benzo(a)pyrene	5.0E-07		7.3E-07	1.2E-06	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	5.0E-08		7.3E-08	1.2E-07	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	5.0E-07		7.3E-07	1.2E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	2.1E-06		2.0E-06	4.1E-06	Exposure Point Total					
						Total Risk Across Soil	3.0E-05					Total Hazard Index Across Soil	
						Total Risk Across Groundwater (from Table 9.10)	3.0E-04					Total Hazard Index Across Groundwater	
						Total Risk Across All Media and All Exposure Routes	3.3E-04					Total Hazard Index Across All Media and All Exposure Routes	

Total [Organ] HI =

Total [Organ] HI =

Total [Organ] HI =

Table 9-11
Summary of Receptor Risks and Hazards for COPC's
Parcel M
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel M Surface Soil (0-0.5 ft.)	Antimony					Antimony		1.8E-01		1.1E-01	3.0E-01
			Arsenic					Arsenic		6.8E-02		1.9E-02	8.7E-02
			Copper					Copper		5.1E-03		4.6E-04	5.5E-03
			Manganese					Manganese		1.6E-02		3.6E-02	5.2E-02
			Mercury					Mercury		1.3E-03		1.7E-03	2.9E-03
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		0.27		0.17	0.44
Soil (0-2 ft.)	Soil (0-2 ft)	Parcel M Gardening Soil (0-2 ft)	Aluminum					Aluminum		6.0E-03		2.0E-03	8.0E-03
			Antimony					Antimony		2.1E-02		1.3E-02	3.4E-02
			Arsenic					Arsenic		7.8E-03		2.1E-03	9.9E-03
			Copper					Copper		5.8E-04		5.3E-05	6.3E-04
			Manganese					Manganese		1.8E-03		4.2E-03	6.0E-03
			Mercury					Mercury		1.5E-04		1.9E-04	3.4E-04
			Nickel					Nickel		3.1E-04		7.0E-04	1.0E-03
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		0.04		0.02	0.06
						Total Risk Across Soil						Total Hazard Index Across Soil	0.50
												Total Hazard Index Across Groundwater (from Table 9.10)	46
						Total Risk Across All Media and All Exposure Routes						Total Hazard Index Across All Media and All Exposure Routes	46

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-12
Summary of Receptor Risks and Hazards for COPC's
Parcel O
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-6 ft.)	Soil (0-6 ft.)	Parcel O Soil (0-6 ft)	Aluminum					Aluminum		1.8E-02		2.8E-03	2.1E-02
			Antimony					Antimony		4.5E-02		1.2E-02	5.7E-02
			Arsenic	1.1E-07		1.4E-08	1.3E-07	Arsenic		2.4E-02		3.0E-03	2.7E-02
			Copper					Copper		2.0E-03		8.2E-05	2.0E-03
			Manganese					Manganese		2.5E-02		2.6E-02	5.1E-02
			Mercury					Mercury		9.3E-04		5.5E-04	1.5E-03
			Nickel					Nickel		2.1E-03		2.2E-03	4.4E-03
			Benzo(a)anthracene	5.6E-09		3.0E-09	8.6E-09	Benzo(a)anthracene					
			Benzo(b)fluoranthene	5.6E-09		3.0E-09	8.6E-09	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	5.6E-10		3.0E-10	8.6E-10	Benzo(k)fluoranthene					
			Benzo(a)pyrene	5.6E-08		3.0E-08	8.6E-08	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	5.6E-09		3.0E-09	8.6E-09	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	5.6E-08		3.0E-08	8.6E-08	Dibenz(a,h)anthracene					
			Chemical Total	2.4E-07		8.4E-08	3.3E-07	Chemical Total		0.12		0.05	0.16
	Particulates	Parcel O Particulates from Soil (0-6 ft.)	Aluminum					Aluminum			5.2E-04		5.2E-04
			Antimony					Antimony					
			Arsenic		3.4E-11		3.4E-11	Arsenic					
			Copper					Copper					
			Manganese					Manganese			2.4E-03		2.4E-03
			Mercury					Mercury			9.5E-08		9.5E-08
			Nickel					Nickel					
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total		3.4E-11		3.4E-11	Chemical Total			2.9E-03		2.9E-03
						Total Risk Across Soil	3.3E-07					Total Hazard Index Across Soil	0.17
						Total Risk Across All Media and All Exposure Routes	3.3E-07					Total Hazard Index Across All Media and All Exposure Routes	0.17

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-12
Summary of Receptor Risks and Hazards for COPC's
Parcel O
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Age-adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel O Surface Soil (0-0.5 ft.)	Antimony					Antimony					
			Arsenic	4.9E-06		3.5E-06	8.4E-06	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Benzo(a)anthracene	2.1E-07		6.4E-07	8.4E-07	Benzo(a)anthracene					
			Benzo(b)fluoranthene	2.1E-07		6.4E-07	8.4E-07	Benzo(b)fluoranthene					
			Benzo(a)pyrene	2.1E-06		6.4E-06	8.4E-06	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	2.1E-07		6.4E-07	8.4E-07	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	2.1E-06		6.4E-06	8.4E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	9.6E-06		1.8E-05	2.8E-05	Exposure Point Total					
Soil (0-2 ft.)	Soil (0-2 ft.)	Parcel O Gardening Soil (0-2 ft)	Aluminum					Aluminum					
			Antimony					Antimony					
			Arsenic	1.2E-06		4.0E-07	1.6E-06	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Nickel					Nickel					
			Benzo(a)anthracene	5.0E-08		7.3E-08	1.2E-07	Benzo(a)anthracene					
			Benzo(b)fluoranthene	5.0E-08		7.3E-08	1.2E-07	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	5.0E-09		7.3E-09	1.2E-08	Benzo(k)fluoranthene					
			Benzo(a)pyrene	5.0E-07		7.3E-07	1.2E-06	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	5.0E-08		7.3E-08	1.2E-07	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	5.0E-07		7.3E-07	1.2E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	2.4E-06		2.1E-06	4.5E-06	Exposure Point Total					
						Total Risk Across Soil	3.2E-05					Total Hazard Index Across Soil	
						Total Risk Across Groundwater (from Table 9.10)	3.0E-04					Total Hazard Index Across Groundwater	
						Total Risk Across All Media and All Exposure Routes	3.3E-04					Total Hazard Index Across All Media and All Exposure Routes	

Total [Organ] HI =
Total [Organ] HI =
Total [Organ] HI =

Table 9-12
Summary of Receptor Risks and Hazards for COPC's
Parcel O
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel O	Antimony					Antimony		1.5E-01		9.1E-02	2.4E-01
		Surface Soil (0-0.5 ft.)	Arsenic					Arsenic		8.9E-02		2.5E-02	1.1E-01
			Copper					Copper		6.5E-03		6.0E-04	7.1E-03
			Manganese					Manganese		9.2E-02		2.1E-01	3.0E-01
			Mercury					Mercury		3.4E-03		4.4E-03	7.9E-03
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		0.34		0.33	0.67
Soil (0-2 ft.)	Soil (0-2 ft)	Parcel O	Aluminum					Aluminum		7.5E-03		2.5E-03	1.0E-02
		Gardening Soil (0-2 ft)	Antimony					Antimony		1.7E-02		1.0E-02	2.8E-02
			Arsenic					Arsenic		1.0E-02		2.8E-03	1.3E-02
			Copper					Copper		8.3E-04		7.5E-05	9.0E-04
			Manganese					Manganese		1.0E-02		2.4E-02	3.4E-02
			Mercury					Mercury		3.9E-04		5.1E-04	9.0E-04
			Nickel					Nickel		9.0E-04		2.1E-03	2.9E-03
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		0.05		0.04	0.09
						Total Risk Across Soil						Total Hazard Index Across Soil	0.76
												Total Hazard Index Across Groundwater (from Table 9.10)	46
						Total Risk Across All Media and All Exposure Routes						Total Hazard Index Across All Media and All Exposure Routes	47

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-13
Summary of Receptor Risks and Hazards for COPC's
Parcel N
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-6 ft.)	Soil (0-6 ft.)	Parcel N Soil (0-6 ft)	Arsenic	1.0E-07		1.3E-08	1.1E-07	Arsenic		2.2E-02		2.7E-03	2.5E-02
			Benzo(a)pyrene	4.8E-08		2.6E-08	7.3E-08	Benzo(a)pyrene					
			Chemical Total	1.5E-07		3.9E-08	1.9E-07	Chemical Total		0.02		2.7E-03	0.02
	Particulates	Parcel N Particulates from Soil (0-6 ft.)	Arsenic		3.0E-11		3.0E-11	Arsenic					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total		3.0E-11		3.0E-11	Chemical Total					
						Total Risk Across Soil	1.9E-07					Total Hazard Index Across Soil	0.02
						Total Risk Across All Media and All Exposure Routes	1.9E-07					Total Hazard Index Across All Media and All Exposure Routes	0.02

Total [Organ] HI =
Total [Organ] HI =
Total [Organ] HI =

Table 9-13
Summary of Receptor Risks and Hazards for COPC's
Parcel N
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Age-adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel N Surface Soil (0-0.5 ft.)	Arsenic	4.4E-06		3.2E-06	7.6E-06	Arsenic					
			Benzo(a)pyrene	2.1E-06		6.4E-06	8.4E-06	Benzo(a)pyrene					
			Exposure Point Total	6.5E-06		9.5E-06	1.6E-05	Exposure Point Total					
Soil (0-2 ft.)	Soil (0-2 ft.)	Parcel N Gardening Soil (0-2 ft)	Arsenic	1.1E-06		3.6E-07	1.4E-06	Arsenic					
			Benzo(a)pyrene	5.0E-07		7.3E-07	1.2E-06	Benzo(a)pyrene					
			Exposure Point Total	1.6E-06		1.1E-06	2.7E-06	Exposure Point Total					
						Total Risk Across Soil	1.9E-05					Total Hazard Index Across Soil	
						Total Risk Across Groundwater (from Table 9.10)	3.0E-04					Total Hazard Index Across Groundwater	
						Total Risk Across All Media and All Exposure Routes	3.2E-04					Total Hazard Index Across All Media and All Exposure Routes	

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-13
Summary of Receptor Risks and Hazards for COPC's
Parcel N
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel N Surface Soil (0-0.5 ft.)	Arsenic					Arsenic		8.0E-02		2.2E-02	1.0E-01
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total					Chemical Total		0.08		0.02	0.10
Soil (0-2 ft.)	Soil (0-2 ft)	Parcel N Gardening Soil (0-2 ft)	Arsenic					Arsenic		9.2E-03		2.5E-03	1.2E-02
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total					Chemical Total		9.2E-03		2.5E-03	0.01
						Total Risk Across Soil						Total Hazard Index Across Soil	0.11
												Total Hazard Index Across Groundwater (from Table 9.1	46
						Total Risk Across All Media and All Exposure Routes						Total Hazard Index Across All Media and All Exposure Routes	46

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-14
Summary of Receptor Risks and Hazards for COPC's
Parcel P
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-6 ft.)	Soil (0-6 ft.)	Parcel P Soil (0-6 ft)	Aluminum					Aluminum		2.0E-02		3.1E-03	2.3E-02
			Antimony					Antimony		4.0E-02		1.1E-02	5.1E-02
			Arsenic	8.2E-08		1.0E-08	9.2E-08	Arsenic		1.7E-02		2.2E-03	2.0E-02
			Copper					Copper		3.3E-03		1.4E-04	3.5E-03
			Manganese					Manganese		2.4E-02		2.5E-02	4.9E-02
			Mercury					Mercury		8.1E-04		4.9E-04	1.3E-03
			Nickel					Nickel		1.4E-03		1.5E-03	2.9E-03
			Benzo(a)anthracene	4.8E-09		2.6E-09	7.4E-09	Benzo(a)anthracene					
			Benzo(b)fluoranthene	4.8E-09		2.6E-09	7.4E-09	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	4.8E-10		2.6E-10	7.4E-10	Benzo(k)fluoranthene					
			Benzo(a)pyrene	4.8E-08		2.6E-08	7.4E-08	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	4.8E-09		2.6E-09	7.4E-09	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	4.8E-08		2.6E-08	7.4E-08	Dibenz(a,h)anthracene					
			Chemical Total	1.9E-07		7.1E-08	2.6E-07	Chemical Total		0.11		0.04	0.15
	Particulates	Parcel P Particulates from Soil (0-6 ft.)	Aluminum					Aluminum			5.8E-04		5.8E-04
			Antimony					Antimony					
			Arsenic		2.4E-11		2.4E-11	Arsenic					
			Copper					Copper					
			Manganese					Manganese			2.3E-03		2.3E-03
			Mercury					Mercury			8.3E-06		8.3E-06
			Nickel					Nickel					
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total		2.4E-11		2.4E-11	Chemical Total			2.9E-03		2.9E-03

Total Risk Across Soil	2.6E-07
Total Risk Across All Media and All Exposure Routes	2.6E-07

Total Hazard Index Across Soil	0.15
Total Hazard Index Across All Media and All Exposure Routes	0.15

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-14
Summary of Receptor Risks and Hazards for COPC's
Parcel P
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Age-adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel P	Antimony					Antimony					
		Surface Soil (0-0.5 ft.)	Arsenic	3.5E-06		2.5E-06	6.0E-06	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Benzo(a)anthracene	2.1E-07		6.4E-07	8.4E-07	Benzo(a)anthracene					
			Benzo(b)fluoranthene	2.1E-07		6.4E-07	8.4E-07	Benzo(b)fluoranthene					
			Benzo(a)pyrene	2.1E-06		6.4E-06	8.4E-06	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	2.1E-07		6.4E-07	8.4E-07	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	2.1E-06		6.4E-06	8.4E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	8.2E-06		1.7E-05	2.5E-05	Exposure Point Total					
Soil (0-2 ft.)	Soil (0-2 ft.)	Parcel P	Aluminum					Aluminum					
		Gardening Soil (0-2 ft)	Antimony					Antimony					
			Arsenic	8.6E-07		2.9E-07	1.2E-06	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Nickel					Nickel					
			Benzo(a)anthracene	5.0E-08		7.3E-08	1.2E-07	Benzo(a)anthracene					
			Benzo(b)fluoranthene	5.0E-08		7.3E-08	1.2E-07	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	5.0E-09		7.3E-09	1.2E-08	Benzo(k)fluoranthene					
			Benzo(a)pyrene	5.0E-07		7.3E-07	1.2E-06	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	5.0E-08		7.3E-08	1.2E-07	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	5.0E-07		7.3E-07	1.2E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	2.0E-06		2.0E-06	4.0E-06	Exposure Point Total					
						Total Risk Across Soil	2.9E-05					Total Hazard Index Across Soil	
						Total Risk Across Groundwater (from Table 9.10)	3.0E-04					Total Hazard Index Across Groundwater	
						Total Risk Across All Media and All Exposure Routes	3.3E-04					Total Hazard Index Across All Media and All Exposure Routes	

Total [Organ] HI =
Total [Organ] HI =
Total [Organ] HI =

Table 9-14
Summary of Receptor Risks and Hazards for COPC's
Parcel P
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel P Surface Soil (0-0.5 ft.)	Antimony					Antimony		1.5E-01		8.9E-02	2.4E-01
			Arsenic					Arsenic		6.4E-02		1.8E-02	8.1E-02
			Copper					Copper		1.2E-02		1.1E-03	1.3E-02
			Manganese					Manganese		8.7E-02		2.0E-01	2.8E-01
			Mercury					Mercury		3.0E-03		3.9E-03	6.9E-03
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		0.31		0.31	0.62
Soil (0-2 ft.)	Soil (0-2 ft)	Parcel P Gardening Soil (0-2 ft)	Aluminum					Aluminum		8.3E-03		2.8E-03	1.1E-02
			Antimony					Antimony		1.7E-02		1.0E-02	2.7E-02
			Arsenic					Arsenic		7.3E-03		2.0E-03	9.3E-03
			Copper					Copper		1.4E-03		1.3E-04	1.5E-03
			Manganese					Manganese		9.9E-03		2.3E-02	3.3E-02
			Mercury					Mercury		3.4E-04		4.4E-04	7.9E-04
			Nickel					Nickel		5.9E-04		1.4E-03	1.9E-03
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		0.04		0.04	0.08
						Total Risk Across Soil						Total Hazard Index Across Soil	0.71
												Total Hazard Index Across Groundwater (from Table 9.10)	46
						Total Risk Across All Media and All Exposure Routes						Total Hazard Index Across All Media and All Exposure Routes	47

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-15
Summary of Receptor Risks and Hazards for COPC's
Parcel S
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Construction Worker
Receptor Age	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-6 ft.)	Soil (0-6 ft.)	Parcel S Soil (0-6 ft)	Aluminum					Aluminum		1.6E-02		2.5E-03	1.9E-02
			Antimony					Antimony		1.1E-01		3.2E-02	1.5E-01
			Arsenic	6.8E-07		8.5E-08	7.6E-07	Arsenic		1.5E-01		1.8E-02	1.6E-01
			Copper					Copper		1.8E-01		7.6E-03	1.9E-01
			Manganese					Manganese		4.0E-02		4.2E-02	8.1E-02
			Mercury					Mercury		2.9E-03		1.7E-03	4.6E-03
			Nickel					Nickel		2.7E-03		2.8E-03	5.5E-03
			Benzo(a)anthracene	4.0E-08		2.1E-08	6.1E-08	Benzo(a)anthracene					
			Benzo(b)fluoranthene	5.0E-08		2.7E-08	7.7E-08	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	1.5E-09		8.0E-10	2.3E-09	Benzo(k)fluoranthene					
			Benzo(a)pyrene	4.0E-07		2.1E-07	6.1E-07	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	1.4E-08		7.7E-09	2.2E-08	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	9.1E-08		4.9E-08	1.4E-07	Dibenz(a,h)anthracene					
			Chemical Total	1.3E-06		4.1E-07	1.7E-06	Chemical Total		0.50		0.11	0.61
	Particulates	Parcel S Particulates from Soil (0-6 ft.)	Aluminum					Aluminum			4.8E-04		4.8E-04
			Antimony					Antimony					
			Arsenic		2.0E-10		2.0E-10	Arsenic					
			Copper					Copper					
			Manganese					Manganese			3.8E-03		3.8E-03
			Mercury					Mercury			3.0E-07		3.0E-07
			Nickel					Nickel					
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total		2.0E-10		2.0E-10	Chemical Total			4.3E-03		4.3E-03
						Total Risk Across Soil	1.7E-06					Total Hazard Index Across Soil	0.61
						Total Risk Across All Media and All Exposure Routes	1.7E-06					Total Hazard Index Across All Media and All Exposure Routes	0.61

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-15
Summary of Receptor Risks and Hazards for COPC's
Parcel S
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Age-adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel S Surface Soil (0-0.5 ft.)	Antimony					Antimony					
			Arsenic	2.9E-05		2.1E-05	5.0E-05	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Benzo(a)anthracene	3.2E-07		9.9E-07	1.3E-06	Benzo(a)anthracene					
			Benzo(b)fluoranthene	6.4E-07		2.0E-06	2.6E-06	Benzo(b)fluoranthene					
			Benzo(a)pyrene	4.9E-06		1.5E-05	2.0E-05	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	6.2E-07		1.9E-06	2.5E-06	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	2.3E-06		7.1E-06	9.4E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	3.8E-05		4.8E-05	8.6E-05	Exposure Point Total					
Soil (0-2 ft.)	Soil (0-2 ft.)	Parcel S Gardening Soil (0-2 ft)	Aluminum					Aluminum					
			Antimony					Antimony					
			Arsenic	7.2E-06		2.4E-06	9.6E-06	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Nickel					Nickel					
			Benzo(a)anthracene	4.2E-07		6.1E-07	1.0E-06	Benzo(a)anthracene					
			Benzo(b)fluoranthene	5.3E-07		7.7E-07	1.3E-06	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	1.6E-08		2.3E-08	3.8E-08	Benzo(k)fluoranthene					
			Benzo(a)pyrene	4.2E-06		6.1E-06	1.0E-05	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	1.5E-07		2.2E-07	3.7E-07	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	5.6E-07		8.1E-07	1.4E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	1.3E-05		1.1E-05	2.4E-05	Exposure Point Total					
						Total Risk Across Soil	1.1E-04					Total Hazard Index Across Soil	
						Total Risk Across Groundwater (from Table 9.10)	3.0E-04					Total Hazard Index Across Groundwater	
						Total Risk Across All Media and All Exposure Routes	4.1E-04					Total Hazard Index Across All Media and All Exposure Routes	

Total [Organ] HI =

Total [Organ] HI =

Total [Organ] HI =

Table 9-15
Summary of Receptor Risks and Hazards for COPC's
Parcel S
Supplemental Site Investigations/Site Characterization Report
Hiinco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel S Surface Soil (0-0.5 ft.)	Antimony					Antimony	blood	4.2E-01		2.5E-01	6.7E-01
			Arsenic					Arsenic	skin	5.3E-01		1.5E-01	6.8E-01
			Copper					Copper		6.7E-01		6.2E-02	7.4E-01
			Manganese					Manganese	CNS	1.5E-01		3.3E-01	4.8E-01
			Mercury					Mercury	CNS/Respiratory	1.1E-02		1.4E-02	2.5E-02
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		1.8		0.8	2.6
Soil (0-2 ft.)	Soil (0-2 ft)	Parcel S Gardening Soil (0-2 ft)	Aluminum					Aluminum		6.9E-03		2.3E-03	9.3E-03
			Antimony					Antimony	blood	4.8E-02		2.9E-02	7.7E-02
			Arsenic					Arsenic	skin	6.1E-02		1.7E-02	7.8E-02
			Copper					Copper		7.7E-02		7.0E-03	8.4E-02
			Manganese					Manganese	CNS	1.7E-02		3.8E-02	5.5E-02
			Mercury					Mercury	CNS/Respiratory	1.2E-03		1.6E-03	2.8E-03
			Nickel					Nickel		8.8E-04		2.0E-03	2.9E-03
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		0.21		0.10	0.31
						Total Risk Across Soil						Total Hazard Index Across Soil	2.9
												Total Hazard Index Across Groundwater (from Table 9.10)	4.6
						Total Risk Across All Media and All Exposure Routes						Total Hazard Index Across All Media and All Exposure Routes	4.9

Total [blood] HI =	0.8
Total [Skin] HI =	0.8
Total [CNS] HI =	0.6

Table 9-16
Summary of Receptor Risks and Hazards for COPC's
Parcel T
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-6 ft.)	Soil (0-6 ft.)	Parcel T Soil (0-6 ft)	Arsenic	2.8E-07		3.5E-08	3.1E-07	Arsenic		5.9E-02		7.4E-03	6.7E-02
			Benzo(a)pyrene	9.5E-08		5.2E-08	1.5E-07	Benzo(a)pyrene					
			Chemical Total	3.7E-07		8.6E-08	4.6E-07	Chemical Total		0.06		0.01	0.07
	Particulates	Parcel T Particulates from Soil (0-6 ft.)	Antimony					Antimony					
			Arsenic		8.2E-11		8.2E-11	Arsenic					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total		8.2E-11		8.2E-11	Chemical Total					
						Total Risk Across Soil	4.6E-07					Total Hazard Index Across Soil	0.07
						Total Risk Across All Media and All Exposure Routes	4.6E-07					Total Hazard Index Across All Media and All Exposure Routes	0.07

Total [Organ] HI =
Total [Organ] HI =
Total [Organ] HI =

Table 9-16
Summary of Receptor Risks and Hazards for COPC's
Parcel T
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Age-adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel T	Arsenic	1.2E-05		8.6E-06	2.0E-05	Arsenic					
		Surface Soil (0-0.5 ft.)	Benzo(a)pyrene	3.8E-06		1.2E-05	1.5E-05	Benzo(a)pyrene					
			Exposure Point Total	1.6E-05		2.0E-05	3.6E-05	Exposure Point Total					
Soil (0-2 ft.)	Soil (0-2 ft.)	Parcel T	Arsenic	2.9E-06		9.8E-07	3.9E-06	Arsenic					
		Gardening Soil (0-2 ft)	Benzo(a)pyrene	9.2E-07		1.3E-06	2.3E-06	*Benzo(a)pyrene*					
			Exposure Point Total	3.9E-06		2.3E-06	6.2E-06	Exposure Point Total					
						Total Risk Across Soil	4.2E-05					Total Hazard Index Across Soil	
						Total Risk Across Groundwater (from Table 9.10)	3.0E-04					Total Hazard Index Across Groundwater	
						Total Risk Across All Media and All Exposure Routes	3.4E-04					Total Hazard Index Across All Media and All Exposure Routes	

Total [Organ] HI =
Total [Organ] HI =
Total [Organ] HI =

Table 9-16
Summary of Receptor Risks and Hazards for COPC's
Parcel T
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel T Surface Soil (0-0.5 ft.)	Arsenic					Arsenic		2.2E-01		6.0E-02	2.8E-01
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total					Chemical Total		0.22		0.06	0.28
Soil (0-2 ft.)	Soil (0-2 ft)	Parcel T Gardening Soil (0-2 ft)	Arsenic					Arsenic		2.5E-02		6.8E-03	3.2E-02
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total					Chemical Total		0.02		0.01	0.03
							Total Risk Across Soil					Total Hazard Index Across Soil	0.31
												Total Hazard Index Across Groundwater (from Table 9.1()	46
							Total Risk Across All Media and All Exposure Routes					Total Hazard Index Across All Media and All Exposure Routes	46

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-17
Summary of Receptor Risks and Hazards for COPC's
Parcel Q
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-6 ft.)	Soil (0-6 ft.)	Parcel Q Soil (0-6 ft)	Arsenic	5.3E-07		6.7E-08	6.0E-07	Arsenic		1.1E-01		1.4E-02	1.3E-01
			Benzo(a)pyrene	1.9E-07		1.0E-07	3.0E-07	Benzo(a)pyrene					
			Chemical Total	7.3E-07		1.7E-07	9.0E-07	Chemical Total		0.11		0.01	0.13
	Particulates	Parcel Q Particulates from Soil (0-6 ft.)	Arsenic		1.6E-10		1.6E-10	Arsenic					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total		1.6E-10		1.6E-10	Chemical Total					
						Total Risk Across Soil	9.0E-07					Total Hazard Index Across Soil	0.13
						Total Risk Across All Media and All Exposure Routes	9.0E-07					Total Hazard Index Across All Media and All Exposure Routes	0.13

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-17
Summary of Receptor Risks and Hazards for COPC's
Parcel Q
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age	Age-adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel Q Surface Soil (0-0.5 ft.)	Arsenic	2.3E-05		1.6E-05	3.9E-05	Arsenic					
			Benzo(a)pyrene	8.3E-06		2.6E-05	3.4E-05	Benzo(a)pyrene					
			Exposure Point Tota	3.1E-05		4.2E-05	7.4E-05	Exposure Point Tota					
Soil (0-2 ft.)	Soil (0-2 ft.)	Parcel Q Gardening Soil (0-2 ft)	Arsenic	5.6E-06		1.9E-06	7.5E-06	Arsenic					
			Benzo(a)pyrene	2.0E-06		3.0E-06	5.0E-06	Benzo(a)pyrene					
			Exposure Point Tota	7.7E-06		4.8E-06	1.3E-05	Exposure Point Total					
						Total Risk Across Soil	8.6E-05					Total Hazard Index Across Soil	
						Total Risk Across Groundwater (from Table 9.10	3.0E-04					Total Hazard Index Across Groundwate	
						Total Risk Across All Media and All Exposure Routes	3.9E-04					Total Hazard Index Across All Media and All Exposure Routes	

Total [Organ] HI =
Total [Organ] HI =
Total [Organ] HI =

Table 9-17
Summary of Receptor Risks and Hazards for COPC's
Parcel Q
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel Q Surface Soil (0-0.5 ft.)	Arsenic					Arsenic		4.2E-01		1.1E-01	5.3E-01
			Benzo(a)pyrene					Benzo(a)pyrene					0.00E+00
			Chemical Total					Chemical Total		0.42		0.11	0.53
Soil (0-2 ft.)	Soil (0-2 ft)	Parcel Q Gardening Soil (0-2 ft)	Arsenic					Arsenic		4.8E-02		1.3E-02	6.1E-02
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total					Chemical Total		0.05		0.01	0.06
						Total Risk Across Soil						Total Hazard Index Across Soil	0.59
												Total Hazard Index Across Groundwater (from Table 9.1	46
						Total Risk Across All Media and All Exposure Routes						Total Hazard Index Across All Media and All Exposure Routes	47

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-18
Summary of Receptor Risks and Hazards for COPC's
Parcel R
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-6 ft.)	Soil (0-6 ft.)	Parcel R Soil (0-6 ft)	Arsenic	2.4E-07		3.1E-08	2.8E-07	Arsenic		5.2E-02		6.5E-03	5.9E-02
			Benzo(a)pyrene	1.2E-07		6.4E-08	1.8E-07	Benzo(a)pyrene					
			Chemical Total	3.6E-07		9.5E-08	4.6E-07	Chemical Total		0.05		0.01	0.06
	Particulates	Parcel R Particulates from Soil (0-6 ft.)	Arsenic		7.2E-11		7.2E-11	Arsenic					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total		7.2E-11		7.2E-11	Chemical Total					
						Total Risk Across Soil	4.6E-07					Total Hazard Index Across Soil	0.06
						Total Risk Across All Media and All Exposure Routes	4.6E-07					Total Hazard Index Across All Media and All Exposure Routes	0.06

Total (Organ) HI =	
Total (Organ) HI =	
Total (Organ) HI =	

Table 9-18
Summary of Receptor Risks and Hazards for COPC's
Parcel R
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Age-adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel R Surface Soil (0-0.5 ft.)	Arsenic	1.1E-05		7.5E-06	1.8E-05	Arsenic					
			Benzo(a)pyrene	5.1E-06		1.6E-05	2.1E-05	Benzo(a)pyrene					
			Exposure Point Total	1.6E-05		2.3E-05	3.9E-05	Exposure Point Total					
Soil (0-2 ft.)	Soil (0-2 ft.)	Parcel R Gardening Soil (0-2 ft)	Arsenic	2.6E-06		8.6E-07	3.5E-06	Arsenic					
			Benzo(a)pyrene	1.3E-06		1.8E-06	3.1E-06	Benzo(a)pyrene					
			Exposure Point Total	3.8E-06		2.7E-06	6.5E-06	Exposure Point Total					
						Total Risk Across Soil	4.6E-05					Total Hazard Index Across Soil	
						Total Risk Across Groundwater (from Table 9.10)	3.0E-04					Total Hazard Index Across Groundwater	
						Total Risk Across All Media and All Exposure Routes	3.5E-04					Total Hazard Index Across All Media and All Exposure Routes	

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-18
Summary of Receptor Risks and Hazards for COPC's
Parcel R
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel R Surface Soil (0-0.5 ft.)	Arsenic					Arsenic		1.9E-01		5.3E-02	2.4E-01
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total					Chemical Total		0.19		0.05	0.24
Soil (0-2 ft.)	Soil (0-2 ft)	Parcel R Gardening Soil (0-2 ft)	Arsenic					Arsenic		2.2E-02		6.0E-03	2.8E-02
			Benzo(a)pyrene					Benzo(a)pyrene					
			Chemical Total					Chemical Total		0.02		0.01	0.03
						Total Risk Across Soil						Total Hazard Index Across Soil	0.27
												Total Hazard Index Across Groundwater (from Table 9.1	46
						Total Risk Across All Media and All Exposure Routes						Total Hazard Index Across All Media and All Exposure Routes	46

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-19
Summary of Receptor Risks and Hazards for COPC's
Parcel F
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Construction Worker
Receptor Age	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-6 ft.)	Soil (0-6 ft.)	Parcel F Soil (0-6 ft)	Aluminum					Aluminum		3.1E-02		4.8E-03	3.6E-02
			Antimony					Antimony		5.8E-02		1.6E-02	7.4E-02
			Arsenic	5.9E-07		7.3E-08	6.6E-07	Arsenic	skin	1.3E-01		1.6E-02	1.4E-01
			Copper					Copper		1.9E-01		8.0E-03	2.0E-01
			Manganese					Manganese	CNS	1.0E-01		1.1E-01	2.1E-01
			Mercury					Mercury	CNS/Respiratory	3.2E-01		1.9E-01	5.2E-01
			Nickel					Nickel		5.2E-02		5.4E-02	1.1E-01
			Benzo(a)anthracene	2.6E-07		1.4E-07	4.0E-07	Benzo(a)anthracene					
			Benzo(b)fluoranthene	2.6E-07		1.4E-07	4.0E-07	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	2.6E-08		1.4E-08	4.1E-08	Benzo(k)fluoranthene					
			Benzo(a)pyrene	2.9E-06		1.6E-06	4.5E-06	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	1.7E-07		9.2E-08	2.6E-07	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	5.3E-07		2.9E-07	8.2E-07	Dibenz(a,h)anthracene					
			Chemical Total	4.7E-06		2.3E-06	7.1E-06	Chemical Total		0.89		0.40	1.3
	Particulates	Parcel F Particulates from Soil (0-6 ft.)	Aluminum					Aluminum			9.0E-04		9.0E-04
			Antimony					Antimony					
			Arsenic		1.7E-10		1.7E-10	Arsenic					
			Copper					Copper					
			Manganese					Manganese			1.0E-02		1.0E-02
			Mercury					Mercury			3.3E-05		3.3E-05
			Nickel					Nickel					
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total		1.7E-10		1.7E-10	Chemical Total			0.01		0.01
						Total Risk Across Soil	7.1E-06					Total Hazard Index Across Soil	1.3
						Total Risk Across All Media and All Exposure Routes	7.1E-06					Total Hazard Index Across All Media and All Exposure Routes	1.3

Total [Skin] HI =	0.14
Total [CNS] HI =	0.74

Table 9-19
Summary of Receptor Risks and Hazards for COPC's
Parcel F
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Age-adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel F Surface Soil (0-0.5 ft.)	Antimony					Antimony					
			Arsenic	1.4E-05		1.0E-05	2.4E-05	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Benzo(a)anthracene	8.9E-07		2.8E-06	3.6E-06	Benzo(a)anthracene					
			Benzo(b)fluoranthene	1.8E-06		5.7E-06	7.5E-06	Benzo(b)fluoranthene					
			Benzo(a)pyrene	1.5E-05		4.6E-05	6.1E-05	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	1.4E-06		4.2E-06	5.6E-06	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	5.1E-06		1.6E-05	2.1E-05	Dibenz(a,h)anthracene					
			Exposure Point Total	3.6E-05		8.5E-05	1.2E-04	Exposure Point Total					
Soil (0-2 ft.)	Soil (0-2 ft.)	Parcel F Gardening Soil (0-2 ft)	Aluminum					Aluminum					
			Antimony					Antimony					
			Arsenic	6.2E-06		2.1E-06	8.3E-06	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Nickel					Nickel					
			Benzo(a)anthracene	4.8E-07		6.9E-07	1.2E-06	Benzo(a)anthracene					
			Benzo(b)fluoranthene	7.8E-07		1.1E-06	1.9E-06	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	3.4E-08		4.8E-08	8.2E-08	Benzo(k)fluoranthene					
			Benzo(a)pyrene	4.8E-06		6.9E-06	1.2E-05	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	3.4E-07		4.8E-07	8.2E-07	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	1.3E-06		1.8E-06	3.1E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	1.4E-05		1.3E-05	2.7E-05	Exposure Point Total					
						Total Risk Across Soil	1.5E-04					Total Hazard Index Across Soil	
						Total Risk Across Groundwater (from Table 9.1)	3.0E-04					Total Hazard Index Across Groundwater	
						Total Risk Across All Media and All Exposure Routes	4.5E-04					Total Hazard Index Across All Media and All Exposure Routes	

Total [Organ] HI =
Total [Organ] HI =
Total [Organ] HI =

Table 9-19
Summary of Receptor Risks and Hazards for COPC's
Parcel F
Supplemental Site Investigation/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel F Surface Soil (0-0.5 ft.)	Antimony					Antimony	blood	1.8E-01		1.1E-01	2.9E-01
			Arsenic					Arsenic	skin	2.6E-01		7.0E-02	3.3E-01
			Copper					Copper		7.7E-02		7.1E-03	8.4E-02
			Manganese					Manganese	CNS	1.6E-01		3.7E-01	5.3E-01
			Mercury					Mercury	CNS/Respiratory	1.2		1.6	2.7
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		1.9		2.1	4.0
Soil (0-2 ft.)	Soil (0-2 ft)	Parcel F Gardening Soil (0-2 ft)	Aluminum					Aluminum		9.1E-03		3.1E-03	1.2E-02
			Antimony					Antimony	blood	2.0E-02		1.2E-02	3.3E-02
			Arsenic					Arsenic	skin	5.3E-02		1.4E-02	6.7E-02
			Copper					Copper		2.4E-02		2.2E-03	2.6E-02
			Manganese					Manganese	CNS	1.8E-02		4.2E-02	6.0E-02
			Mercury					Mercury	CNS/Respiratory	1.4E-01		1.8E-01	3.1E-01
			Nickel					Nickel		1.7E-03		4.0E-03	5.7E-03
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		0.26		0.26	0.52
						Total Risk Across Soil						Total Hazard Index Across Soil	4.5
												Total Hazard Index Across Groundwater (from Table 9.2)	46
						Total Risk Across All Media and All Exposure Routes						Total Hazard Index Across All Media and All Exposure Routes	50

Total [CNS] HI =	3.6
Total [Skin] HI =	0.39
Total [Blood] HI =	0.32

Table 9-20
Summary of Receptor Risks and Hazards for COPC's
Parcel D
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-6 ft.)	Soil (0-6 ft.)	Parcel D Soil (0-6 ft)	Aluminum					Aluminum		1.8E-02		2.8E-03	2.1E-02
			Antimony					Antimony		6.0E-02		1.7E-02	7.7E-02
			Arsenic	3.3E-07		4.1E-08	3.7E-07	Arsenic		7.1E-02		8.8E-03	8.0E-02
			Copper					Copper		9.8E-03		4.1E-04	1.0E-02
			Manganese					Manganese		2.8E-02		2.9E-02	5.6E-02
			Mercury					Mercury		2.3E-03		1.4E-03	3.7E-03
			Nickel					Nickel		2.6E-03		2.7E-03	5.2E-03
			Benzo(a)anthracene	2.9E-08		1.6E-08	4.5E-08	Benzo(a)anthracene					
			Benzo(b)fluoranthene	4.5E-08		2.4E-08	6.9E-08	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	5.6E-09		3.0E-09	8.6E-09	Benzo(k)fluoranthene					
			Benzo(a)pyrene	3.7E-07		2.0E-07	5.7E-07	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	2.9E-08		1.6E-08	4.5E-08	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	9.5E-08		5.2E-08	1.5E-07	Dibenz(a,h)anthracene					
			Chemical Total	9.1E-07		3.5E-07	1.3E-06	Chemical Total		0.19		0.06	0.25
	Particulates	Parcel D Particulates from Soil (0-6 ft.)	Aluminum					Aluminum			5.3E-04		5.3E-04
			Antimony					Antimony					
			Arsenic		9.8E-11		9.8E-11	Arsenic					
			Copper					Copper					
			Manganese					Manganese			2.7E-03		2.7E-03
			Mercury					Mercury			2.4E-07		2.4E-07
			Nickel					Nickel					
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total		9.8E-11		9.8E-11	Chemical Total			3.2E-03		3.2E-03
						Total Risk Across Soil	1.3E-06					Total Hazard Index Across Soil	0.26
						Total Risk Across All Media and All Exposure Routes	1.3E-06					Total Hazard Index Across All Media and All Exposure Routes	0.26

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-20
Summary of Receptor Risks and Hazards for COPC's
Parcel D
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age	Age-adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel D	Antimony					*Antimony*					
		Surface Soil (0-0.5 ft.)	Arsenic	8.0E-06		5.7E-06	1.4E-05	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Benzo(a)anthracene	3.5E-07		1.1E-06	1.4E-06	*Benzo(a)anthracene*					
			Benzo(b)fluoranthene	4.3E-07		1.3E-06	1.8E-06	Benzo(b)fluoranthene					
			Benzo(a)pyrene	4.9E-06		1.5E-05	2.0E-05	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	4.2E-07		1.3E-06	1.7E-06	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	1.5E-06		4.6E-06	6.1E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	1.6E-05		2.9E-05	4.5E-05	Exposure Point Total					
Soil (0-2 ft.)	Soil (0-2 ft.)	Parcel D	Aluminum					Aluminum					
		Gardening Soil (0-2 ft)	Antimony					*Antimony*					
			Arsenic	3.5E-06		1.2E-06	4.7E-06	Arsenic					
			Copper					Copper					
			Manganese					Manganese					
			Mercury					Mercury					
			Nickel					Nickel					
			Benzo(a)anthracene	3.1E-07		4.4E-07	7.5E-07	Benzo(a)anthracene					
			Benzo(b)fluoranthene	4.8E-07		6.9E-07	1.2E-06	Benzo(b)fluoranthene					
			Benzo(k)fluoranthene	5.9E-08		8.5E-08	1.4E-07	Benzo(k)fluoranthene					
			Benzo(a)pyrene	3.9E-06		5.7E-06	9.6E-06	Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene	3.1E-07		4.4E-07	7.5E-07	Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene	1.0E-06		1.5E-06	2.5E-06	Dibenz(a,h)anthracene					
			Exposure Point Total	9.6E-06		9.9E-06	2.0E-05	Exposure Point Total					
						Total Risk Across Soil	6.4E-05					Total Hazard Index Across Soil	
						Total Risk Across Groundwater (from Table 9.1)	3.0E-04					Total Hazard Index Across Groundwater	
						Total Risk Across All Media and All Exposure Routes	3.6E-04					Total Hazard Index Across All Media and All Exposure Routes	

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-20
Summary of Receptor Risks and Hazards from COPC's
Parcel D
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (0-0.5 ft)	Surface Soil (0-0.5 ft.)	Parcel D Surface Soil (0-0.5 ft.)	Antimony					Antimony		1.8E-01		1.1E-01	2.9E-01
			Arsenic					Arsenic		1.4E-01		4.0E-02	1.8E-01
			Copper					Copper		1.6E-02		1.5E-03	1.8E-02
			Manganese					Manganese		1.0E-01		2.3E-01	3.3E-01
			Mercury					Mercury		2.6E-03		3.3E-03	5.9E-03
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		0.44		0.38	0.83
Soil (0-2 ft.)	Soil (0-2 ft)	Parcel D Gardening Soil (0-2 ft)	Aluminum					Aluminum		6.0E-03		2.0E-03	8.1E-03
			Antimony					Antimony		2.1E-02		1.3E-02	3.3E-02
			Arsenic					Arsenic		3.0E-02		8.1E-03	3.8E-02
			Copper					Copper		3.5E-03		3.8E-04	3.9E-03
			Manganese					Manganese		2.7E-02		2.6E-02	5.4E-02
			Mercury					Mercury		9.7E-04		1.3E-03	2.2E-03
			Nickel					Nickel		1.1E-03		2.5E-03	3.5E-03
			Benzo(a)anthracene					Benzo(a)anthracene					
			Benzo(b)fluoranthene					Benzo(b)fluoranthene					
			Benzo(k)fluoranthene					Benzo(k)fluoranthene					
			Benzo(a)pyrene					Benzo(a)pyrene					
			Indeno(1,2,3-cd)pyrene					Indeno(1,2,3-cd)pyrene					
			Dibenz(a,h)anthracene					Dibenz(a,h)anthracene					
			Chemical Total					Chemical Total		0.09		0.05	0.14
						Total Risk Across Soil						Total Hazard Index Across Soil	0.97
												Total Hazard Index Across Groundwater (from Table 9.2	46
						Total Risk Across All Media and All Exposure Routes						Total Hazard Index Across All Media and All Exposure Routes	47

Total [Organ] HI =	
Total [Organ] HI =	
Total [Organ] HI =	

Table 9-21
Summary of Uncertainties Associated with the Human Health Risk Estimates
for the Construction Debris Area and Downgradient Ground Water
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

UNCERTAINTY	MAGNITUDE (high, med, low)	PROBABLE EFFECT ON RISK ESTIMATES		
		OVERESTIMATE	UNDERESTIMATE	OVER- OR UNDERESTIMATE
Sampling design				
soils	high			X
ground water	high	X		
Selection of COPCs				
analytical methods	low	X		
data qualifiers	low			X
site-relatedness	low	X		
essential nutrients	med			X
toxicity screen	low	X		
duplicate analyses	low			X
Receptors	low	X		
EPCs				
soils (max. detect)	low	X		
ground water				
max. detect	low	X		
air (modeled)	low	X		
Exposure Parameters	med	X		
Exposure Routes	low			X
Toxicity Values				
CSF	med	X		
RfD_o	med	X		
RfD_i	med			X
Lead	med		X	
Risk Characterization	unknown			X

Table 10-1
Occurrence, Distribution and Selection of COPC's
Eastern Downgradient Ground Water Data Set
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Medium: Ground Water
Exposure Medium: Ground Water
Exposure Point: Tap Water/Water Vapor

Chemical	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Concentration Used for Screening (max)	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
Inorganics												
Aluminum	321		ug/L	WT101A95	5/10	321	99.3	3700 N	50	SMCL	no	BSL
Arsenic	24.3	J	ug/L	WT114A98	10/10	24.3	1.2	0.045 C	10	MCL	yes	ASL
Barium	238	J	ug/L	WT114A98	10/10	238	41.3	260 N	2000	MCL	no	BSL
Beryllium	0.6	J	ug/L	WT114A98/ WT101A11/00	2/10	0.6	0.68	7.3 N	4	MCL	no	BKG/BSL
Cadmium	1.7	J	ug/L	WT114A95	2/10	1.7	1.5	1.8 N	5	MCL	no	BSL
Calcium	377,000		ug/L	WT101A98	10/10	377,000	132,016	400,000			no	<NUT
Chromium	13.1		ug/L	*WT101A98*	*3/10*	13.1	12.5	*11 N*	*100*	MCL	*yes*	BKG/ASL
Cobalt	13.8	J	ug/L	WT114A95	7/10	13.8	5.8	220 N			no	BSL
Iron	28,100		ug/L	WT101A98	10/10	28100	49.2	5000/11,000N	300	SMCL	yes	>NUT/ASL
Magnesium	30,500		ug/L	WT114B-95	10/10	30,500	16,250	75,000			no	<NUT
Manganese	3,080		ug/L	WT101A98	10/10	3080	31.6	88 N	50	SMCL	yes	ASL
Mercury	0.011	J	ug/L	WT114A04/00	1/10	0.011	0.01	1.1 N	2	MCL	no	BSL
Nickel	23.8	J	ug/L	WT101A95	4/10	23.8	31.9	73 N	100	MCL	no	BKG/BSL
Potassium	10,100		ug/L	WT101A11/00	10/10	10,100	1795	900,000			no	<NUT
Sodium	125,000	J	ug/L	WT114A04/00	10/10	125,000	39950	1,200,000			no	<NUT
Thallium	6.7	J	ug/L	WT114A95	1/10	6.7	1.8	0.24 N	2	MCL	yes	ASL
Vanadium	23.2	J	ug/L	WT114B95	4/10	23.2	9.9	26 N			no	BSL
Zinc	7.6	J	ug/L	WT114A95	4/10	7.6	8.45	1100 N	5000	SMCL	no	BKG/BSL
Cyanide	17.9	J	ug/L	WT101A98	2/2	17.9	6.5	73 N	200	MCL		BSL

(1) Maximum detected concentration from data set described in Section 10.3.1.

(2) The arithmetic mean of upgradient well-pair WT102A/WT112A based on '95/'98/'00 combined ground water data. Constituents not detected were replaced by one-half the quantitation limit.

(3) *Preliminary Remediation Goals* Table, U.S. EPA Region 9, (Cancer benchmark value = 1E-06, HQ=0.1), or chemical-specific Recommended Daily Allowances (RDAs) or Daily Dietary Intakes.

(4) Rationale Codes
Above Screening Levels (ASL)
Background Levels (BKG)
No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

Definitions:
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
ND = Not Detected or Not Determined
MCL = Federal Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
AL = Action Level
J = Estimated Value
C = Carcinogenic
N = Non-Carcinogenic

Table 10-1
Occurrence, Distribution and Selection of COPC's
Eastern Downgradient Ground Water Data Set
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe: Current/Future
Medium: Ground Water
Exposure Medium: Ground Water
Exposure Point: Tap Water/Water Vapor

Chemical	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Concentration Used for Screening (Max)	Background Value (2)	Screening Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
Volatile Organics												
Ethyl ether	49		ug/L	WT101A11/00	1/2	49	ND	none			no	NTX
dichlorofluoromethane	6		ug/L	WT101A11/00	1/2	6	ND	none			no	NTX
chloroethane	2		ug/L	WT101A-04/00 GP101-2-04/00	2/18	2	ND	none			no	NTX
Methylene Chloride	0.7	J	ug/L	WT101A95	1/18	0.7	ND	4.3 C	5	MCL	no	BSL
Carbon Disulfide	2	J	ug/L	WT114B	4/18	2	ND	100 N			no	BSL
1,1-Dichloroethane	14.0		ug/L	WT101A-11/00	15/18	14.0	ND	81 N			no	BSL
total 1,2-Dichloroethene	1.0	J	ug/L	WT114B-95	1/7	1.0	ND	6.1 N			no	BSL
cis-1,2-dichloroethene	1.0		ug/L	GP114-2-05/00	3/11	1.0	ND	6.1 N	70	MCL	no	BSL
1,2-dichloropropane	2.0		ug/L	GP114-2/GP16-1 05/00	2/18	2.0	ND	0.16 C	5	MCL	yes	ASL
trichloroethene	0.5	J	ug/L	GP16-1- 05/00	1/18	0.5	ND	1.6 C	5	MCL	no	BSL
benzene	3.0	J	ug/L	WT101A'90/'91	8/18	3.0	ND	0.35	5	MCL	yes	ASL
Semivolatile Organics												
diethylphthalate	20.0		ug/L	WT101A91	6/18	20.0	ND	2,900 N			no	BSL
dimethylphthalate	7.0	J	ug/L	WT101A98	1/18	7.0	ND	3,600 N			no	BSL
butylbenzylphthalate	0.2	J	ug/L	WT114B-95	1/18	0.2	ND	6.1 N			no	BSL
bis(2-Ethylhexyl)phthalate	8.0		ug/L	WT101A -05/00	7/18	8.0	ND	4.8 C	6	MCL	yes	ASL

(1) Maximum detected concentration from data set described in Section 10.3.1

(2) The arithmetic mean of upgradient well-pair WT102A/WT112A based on '95/'98/'00 combined ground water data

Constituents not detected were replaced by one-half the quantitation limit.

(3) Preliminary Remediation Goals Table, U.S. EPA Region 9, (Cancer benchmark value = 1E-06, HQ=0.1), or chemical-specific Recommended Daily Allowances (RDAs) or Daily Dietary Intakes

(4) Rationale Codes

Above Screening Levels (ASL)

Background Levels (BKG)

No Toxicity Information (NTX)

Essential Nutrient (NUT)

Below Screening Level (BSL)

Definitions:

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

ND = Not Detected or Not Determined

MCL = Federal Maximum Contaminant Level

SMCL = Secondary Maximum Contaminant Level

AL = Action Level

J = Estimated Value

C = Carcinogenic

N = Non-Carcinogenic

Table 10-2
Summary of Receptor Risks and Hazards for COPC's
Eastern Downgradient Ground Water
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Age-Adjusted

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Ground water	Ground water	Downgradient Ground Water(eastern) - Tap Water	Arsenic	5.4E-04		1.8E-06	5.5E-04						
			Iron										
			Manganese										
			Thallium										
			Bis(2-ethylhexyl)phthalate	1.7E-06		3.6E-06	5.3E-06						
			Benzene	2.5E-06		3.9E-07	2.9E-06						
			1,2-Dichloropropane	2.0E-06		1.9E-07	2.2E-06						
			Exposure Point Total	5.5E-04		5.9E-06	5.6E-04						
	Air	Water Vapors from Showerhead	Benzene		1.9E-06		1.9E-06						
			1,2-Dichloropropane										
			Exposure Point Total		1.9E-06		1.9E-06						
		Water Vapors from Household Use	Benzene		2.0E-05		2.0E-05						
			1,2-Dichloropropane										
			Exposure Point Total		2.0E-05		2.0E-05						
						Total Risk Across Groundwater	5.8E-04					Total Hazard Index Across Groundwater	

Table 10-2
Summary of Receptor Risks and Hazards for COPC's
Eastern Downgradient Ground Water
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child

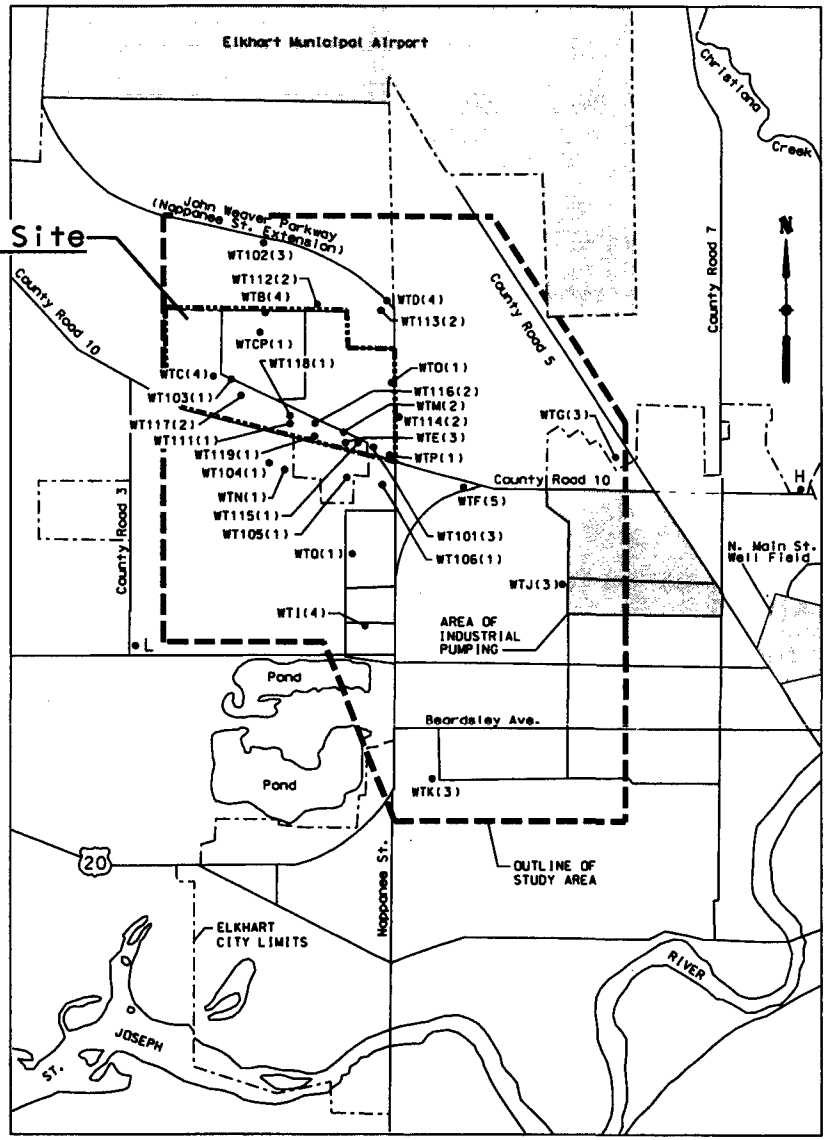
Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total		Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Ground water	Ground water	Downgradient Ground Water (eastern) - Tap Water	Arsenic					Arsenic	skin	5.2		2.8E-02	5.2
			Iron					Iron	liver	6.0		6.6E-01	6.6
			Chromium					Chromium		2.8E-01		1.5E-01	4.3E-01
			Manganese					Manganese	CNS	4.2		5.7E-01	4.8
			Thallium					Thallium	blood/hair loss	5.4		2.9E-02	5.4
			Bis(2-ethylhexyl)phthalate					Bis(2-ethylhexyl)phthalate		2.6E-02		6.8E-02	9.3E-02
			Benzene					Benzene		6.4E-02		1.2E-02	7.6E-02
			1,2-Dichloropropane					1,2-Dichloropropane					
			Exposure Point Total					Exposure Point Total		21		1.5	23
	Air	Bathing - Represented by water vapors from showerhead	Benzene					Benzene	blood		9.5E-01		9.5E-01
			1,2-Dichloropropane					1,2-Dichloropropane	respiratory		9.5E-01		9.5E-01
			Exposure Point Total					Exposure Point Total			1.9		1.9
		Household Use	Benzene					Benzene	blood		2.2		2.2
			1,2-Dichloropropane					1,2-Dichloropropane	respiratory		2.2		2.2
			Exposure Point Total					Exposure Point Total			4.4		4.4
							Total Risk Across Ground wate						Total Hazard Index Across Ground wate 29

Total [skin] HI =	5.2
Total [liver] HI =	6.0
Total [CNS] HI =	4.2
Total [respiratory] HI =	3.2
Total [blood/hair loss] HI =	8.6

Table 10-3
Summary of Uncertainties Associated with the Human Health Risk Estimates
for the Eastern Off-Site Residential Area
Supplemental Site Investigations/Site Characterization Report
Himco Dump Superfund Site
Elkhart, Indiana

UNCERTAINTY	MAGNITUDE (high, med, low)	PROBABLE EFFECT ON RISK ESTIMATES		
		OVERESTIMATE	UNDERESTIMATE	OVER- OR UNDERESTIMATE
Sampling design				
ground water	med		X	
residential wells	high		X	
Selection of COPCs				
data qualifiers	low			X
site-relatedness	low	X		
essential nutrients	low			X
toxicity screen	low			X
duplicate analyses	low			X
Receptors	low	X		
EPCs				
max. detections	med	X		
ambient/indoor air	low		X	
Exposure Parameters	med	X		
Exposure Routes	low			X
Toxicity Values				
CSF	med	X		
RfD_o	med	X		
RfD_i	med			X
Risk Characterization	unknown			X

Figures



NOT TO SCALE

LOCATION PLAN
NOT TO SCALE

LEGEND

- • WTK — Monitoring well site and site designation.
- (3) — Number of monitoring wells at a site.

NOTE

USGS monitoring wells have been redesignated by adding a "WT" to the beginning of each well number (i.e. well K is redesignated WTK).

FIGURE 1-1

$$ – THINK VALUE ENGINEERING – $$

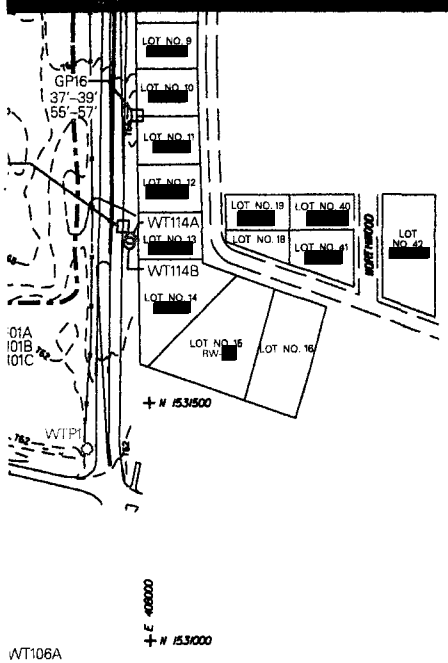
Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

ELKHART, INDIANA

SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
SITE LOCATION MAP

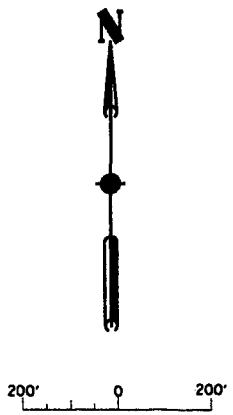
Designed by: R.J.G.	Date: JUNE 2002	Sheet Number:	
Drawn by: J.A.H.	Spec. No.: DACA 45-	Drawing Code:	
Checked by: R.J.G.	Contract No.: DACA 45-	X	X
Reviewed by:			
Submitted by:			
Chief: GSB/EP & Section			



NOTES:

1. THE WTG WELL CLUSTER IS LOCATED APPROXIMATELY 0.6 MILES EAST-NORTHEAST OF THE INTERSECTION OF COUNTY ROAD 10 AND JOHN WEAVER PARKWAY, AND CANNOT BE SHOWN ON THIS MAP.
2. THE WTJ WELL CLUSTER IS LOCATED APPROXIMATELY 0.55 MILES SOUTHEAST OF THE INTERSECTION OF COUNTY ROAD 10 AND JOHN WEAVER PARKWAY, AND CANNOT BE SHOWN ON THIS MAP.

FIGURE 2-1



COMPUTER AIDED DESIGN & DRAFTING

$$ - THINK VALUE ENGINEERING - $$

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

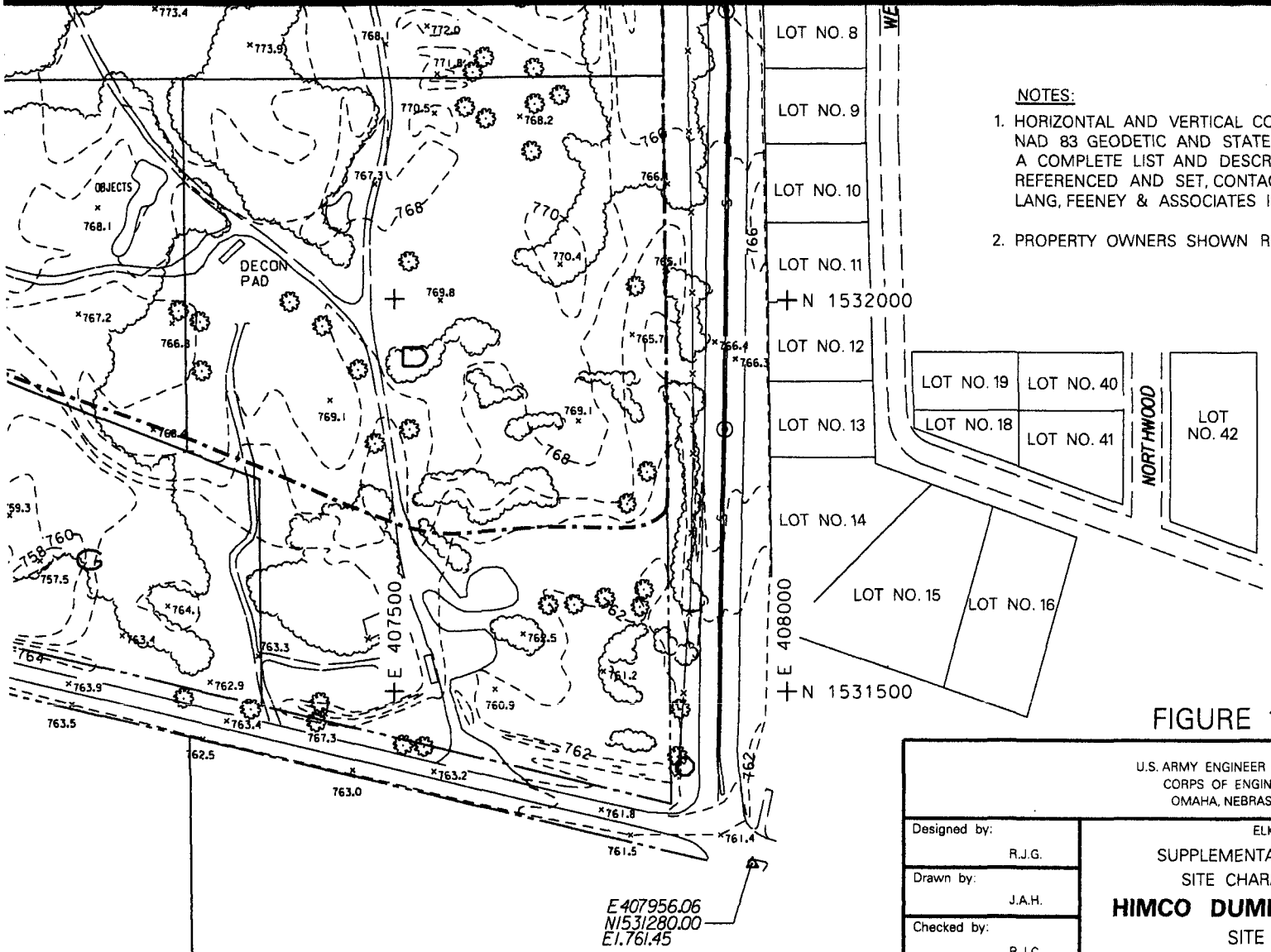
Designed by: R.J.G.	ELKHART, INDIANA
Drawn by: J.A.H.	SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
Checked by: R.J.G.	**HIMCO DUMP SUPERFUND SITE**
Reviewed by: X	MONITORING, RESIDENTIAL WELL AND DIRECT PUSH SAMPLING LOCATIONS
Submitted by: Chief: GEOLOGY A Section	Plot Scale Ratio: 200:1 / Design File: eh01mw.dgn / Date: JUNE 2002 / Spec. No.: DACA 45 / Contract No.: DACA 45 / Drawing Code: X / Sheet reference number: X

B

A

2

1



NOTES:

1. HORIZONTAL AND VERTICAL CONTROL IS ACCORDING TO NAD 83 GEODETIC AND STATE PLANE COORDINATES. FOR A COMPLETE LIST AND DESCRIPTION OF CONTROL POINTS REFERENCED AND SET, CONTACT THE USEPA AND /OR LANG, FEENEY & ASSOCIATES INC.
2. PROPERTY OWNERS SHOWN REFLECT OWNERS IN 1998.

FIGURE 1–2

SCALE : 1 INCH = 100 FEET

COMPUTER AIDED DESIGN & DRAFTING

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

ELKHART, INDIANA

SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT

HIMCO DUMP SUPERFUND SITE

SITE FEATURES MAP

Designed by: R.J.G.	Plot Scale Ratio: 100:1	Date: SEPTEMBER 2002	Sheet number:
Drawn by: J.A.H.	Design File: eh01g1001a.dgn		
Checked by: R.J.G.	Spec. No.: DACA 45	Drawing Code: DER128-400E	X
Reviewed by:	Contract No.: DACA 45		
Chief: GEOLOGY A Section			

B

A

2 1

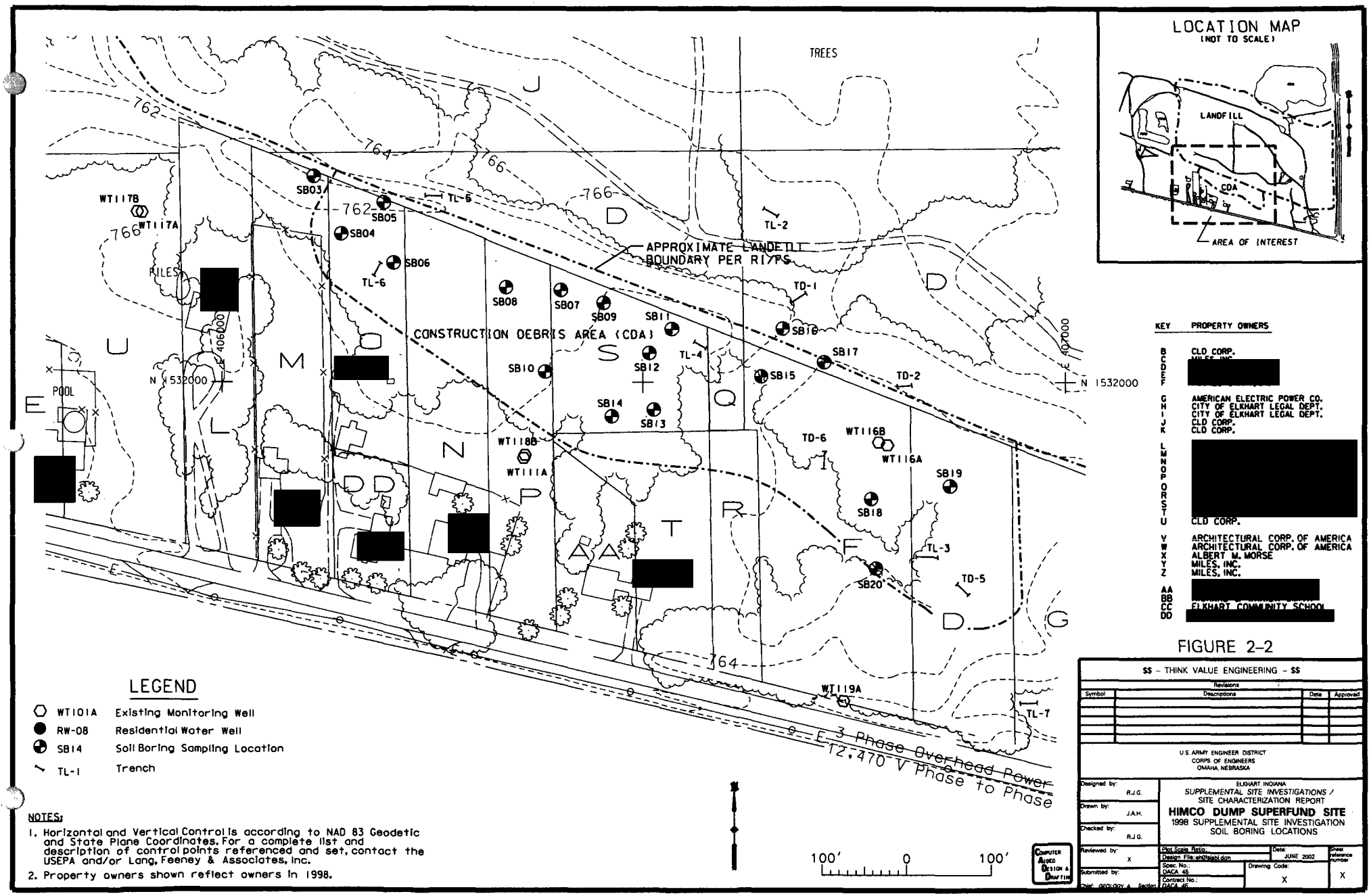


FIGURE 2-2

$$ – THINK VALUE ENGINEERING – $$

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.J.G.
Drawn by: J.A.H.
Checked by: R.J.G.
Reviewed by: X
Submitted by:
Chief, GEOLOGY & Section

ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
1998 SUPPLEMENTAL SITE INVESTIGATION
SOIL BORING LOCATIONS

Plot Scale Ratio:
Design File: eh01sbl.dgn
Spec. No.: DACA 45
Contract No.: DACA 45
Date: JUNE 2002
Drawing Code: X
Sheet reference number: X

COMPUTER AIDED DESIGN & DRAFTING

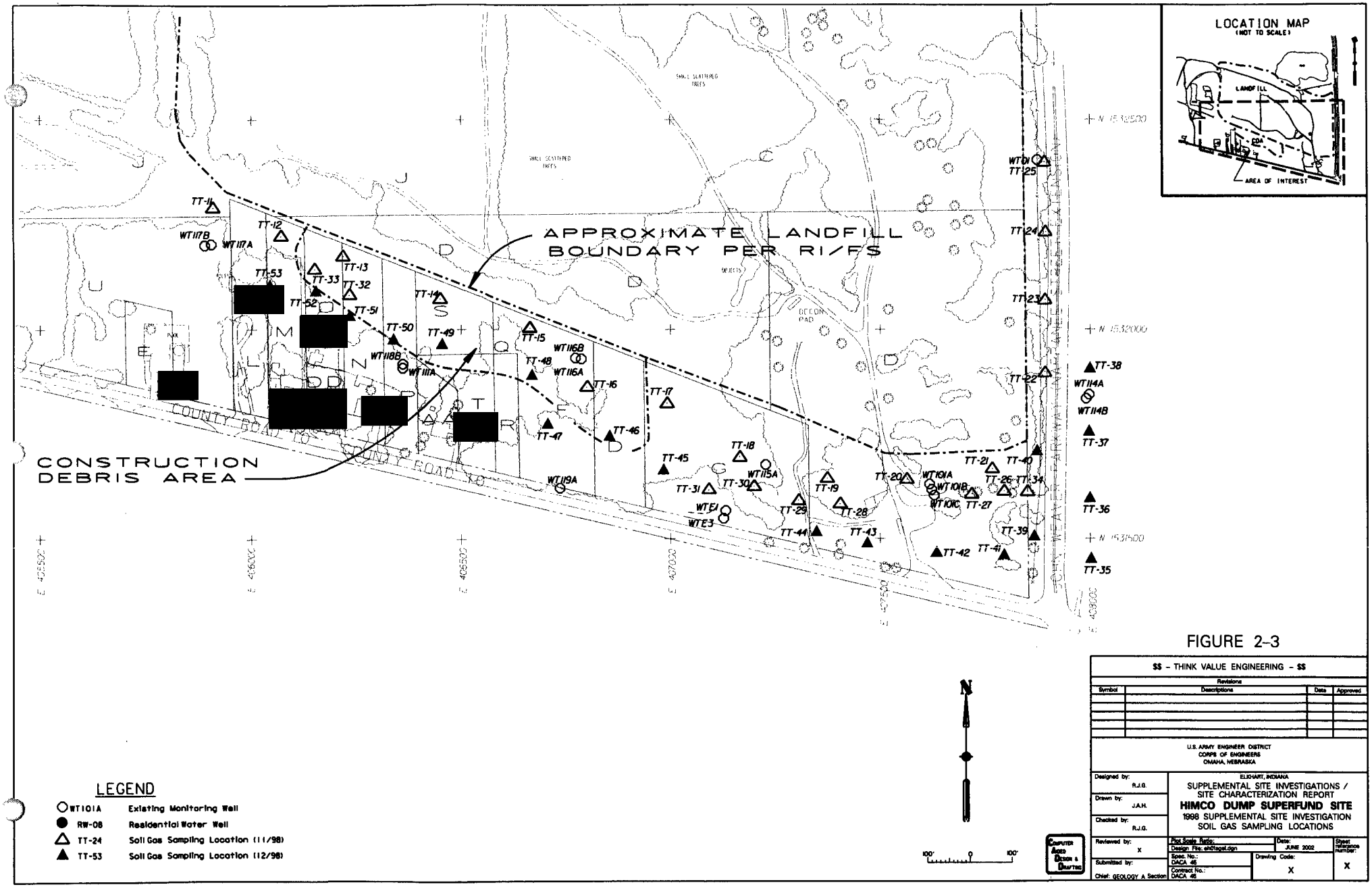


FIGURE 2-3

$$ - THINK VALUE ENGINEERING - $$

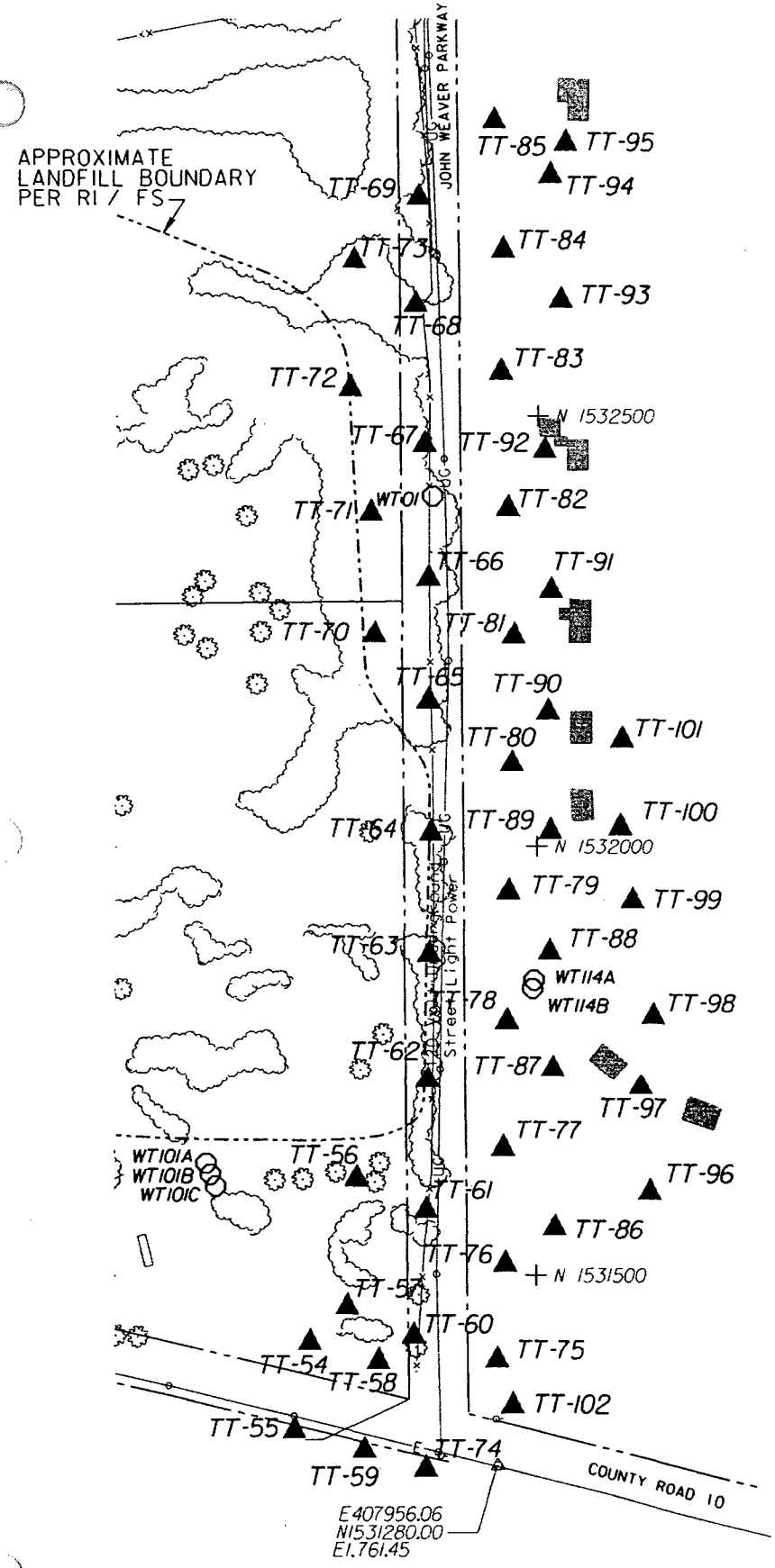
Revisions			
Symbol	Descriptions	Date	Approved

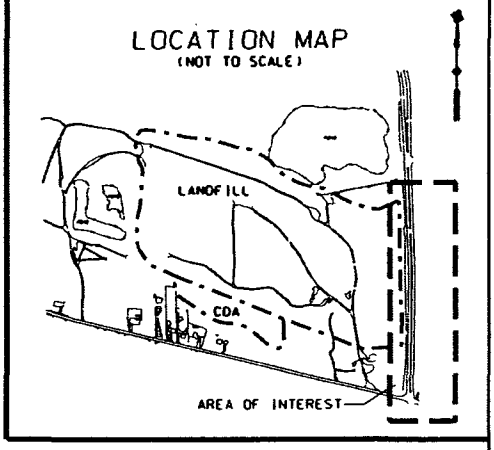
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

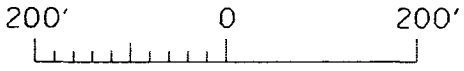
ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
1998 SUPPLEMENTAL SITE INVESTIGATION
SOIL GAS SAMPLING LOCATIONS

Designed by: R.J.G.	Plot Scale Ratio:	Date: JUNE 2002	Sheet Information Number:
Drawn by: J.A.H.	Design File: sh01sgsel.dgn		
Checked by: R.J.G.	Spec. No.: DACA 46	Drawing Code:	X
Reviewed by: X	Contract No.: DACA 46	X	
Submitted by: Chief, GEOLOGY & Section			

COMPUTER AIDED DESIGN & DRAFTING







LEGEND

- WT101A — Existing Monitoring Well
- TT-54 — Soil Gas Sampling Location
- Outline of Residential Building

FIGURE 2-4

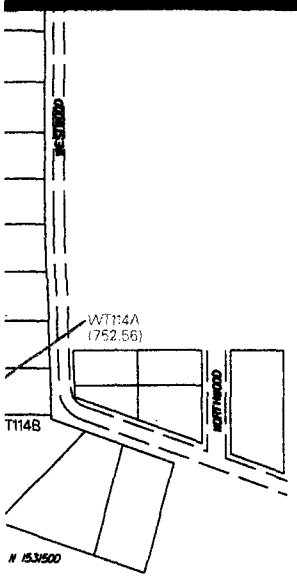
$S – THINK VALUE ENGINEERING - $S

Revisions

Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.J.G	ELKHART, INDIANA SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT **HIMCO DUMP SUPERFUND SITE** 1999 SUPPLEMENTAL SITE INVESTIGATION SOIL GAS SAMPLING LOCATIONS
Drawn by: J.A.H	
Checked by: R.J.G	
Reviewed by:	Plot Scale Ratio: X; Date: JUNE 2000; Sheet reference number:
	Design File: em01gsites8.dgn
Submitted by: Chief: GEOLOGY & Section	Spec. No.: DACA 45; Drawing Code: X
	Contract No.: DACA 45; X



N 1531000

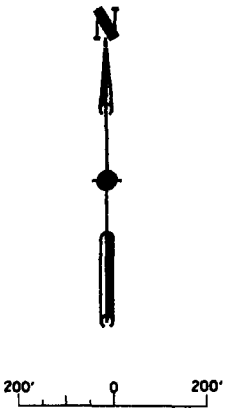
41-43 THE LOCATION SYMBOL.

754 GROUND WATER ELEVATION CONTOUR. RED COLORED LINES REPRESENT A POTENTIAL MOUNDING EFFECT OF THE LANDFILL. BLUE COLORED LINES REPRESENT NO MOUNDING EFFECT OF THE LANDFILL. ALL LINES DASHED WHERE APPROXIMATE.

NOTES:

1. THE WTG WELL CLUSTER IS LOCATED APPROXIMATELY 0.6 MILES EAST-NORTHEAST OF THE INTERSECTION OF COUNTY ROAD 10 AND JOHN WEAVER PARKWAY, AND CANNOT BE SHOWN ON THIS MAP.
2. THE WTJ WELL CLUSTER IS LOCATED APPROXIMATELY 0.55 MILES SOUTHEAST OF THE INTERSECTION OF COUNTY ROAD 10 AND JOHN WEAVER PARKWAY, AND CANNOT BE SHOWN ON THIS MAP.

FIGURE 3-1



COMPUTER AIDED DESIGN & DRAFTING

$$ - THINK VALUE ENGINEERING - $$

Revisions

Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

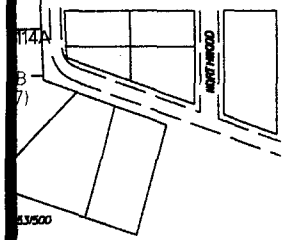
Designed by: R.J.G.
Drawn by: J.A.H.
Checked by: R.J.G.
Reviewed by: X
Submitted by:
Chief: GEOLOGY A Section

ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
GROUND WATER ELEVATION CONTOURS
SHALLOW MONITORING WELLS
APRIL 2000

Plot Scale Ratio: 200:1
Design File: EH01geotechmounding.dgn
Date: FEBRUARY 2002
Spec. No.: DACA 45
Contract No.: DACA 45
Drawing Code: X
Sheet reference number: X

2 1

B A



GPE
30'-32'
35'-37'
41'-43'

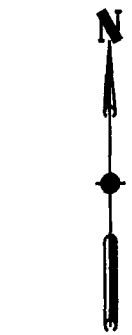
DIRECT PUSH GROUND WATER SAMPLING LOCATION. SAMPLING DEPTHS ARE NOTED ADJACENT TO THE LOCATION SYMBOL.

755

GROUND WATER ELEVATION CONTOUR (DASHED WHERE APPROXIMATE)

NOTES:

1. THE WTG WELL CLUSTER IS LOCATED APPROXIMATELY 0.6 MILES EAST-NORTHEAST OF THE INTERSECTION OF COUNTY ROAD 10 AND JOHN WEAVER PARKWAY, AND CANNOT BE SHOWN ON THIS MAP.
2. THE WTJ WELL CLUSTER IS LOCATED APPROXIMATELY 0.55 MILES SOUTHEAST OF THE INTERSECTION OF COUNTY ROAD 10 AND JOHN WEAVER PARKWAY, AND CANNOT BE SHOWN ON THIS MAP.



200' 0 200'

FIGURE 3-2

$$ – THINK VALUE ENGINEERING – $$

Revisions

Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.J.G.
Drawn by: J.A.H.
Checked by: R.J.G.
Reviewed by: X
Submitted by:
Chief: GEOLOGY & Section

ELKHART, INDIANA

SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT

HIMCO DUMP SUPERFUND SITE

GROUND WATER ELEVATION CONTOURS INTERMEDIATE MONITORING WELLS APRIL 2000

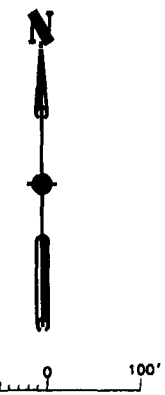
Plot Scale Ratio: 200:1
Design File: EH01geotechbdesign.dgn
Date: FEBRUARY 2002
Spec. No.: DACA 45
Contract No.: DACA 45
Drawing Code: X
Sheet reference number: X

COMPUTER AIDED DESIGN & DRAFTING

B

A

2 1



g/m³
Analyzed.

COMPUTER AIDED DESIGN & DRAFTING

FIGURE 5–1

$$ – THINK VALUE ENGINEERING – $$

Revisions

Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.J.G.	ELKHART, INDIANA SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT **HIMCO DUMP SUPERFUND SITE** 1998 SUPPLEMENTAL SITE INVESTIGATION SOIL GAS ISOCONCENTRATION MAP TOTAL BTEX
Drawn by: J.A.H.	
Checked by: R.J.G.	
Reviewed by: X	Plot Scale Ratio:
Submitted by: Chief: GEOLOGY A Section	Design File: eh01sglbtx-1.dgn Date: JUNE 2002 Sheet reference number: X Spec. No.: DACA 45 Drawing Code: X Contract No.: DACA 45

B

A

2 1

1/98)

2/98)

ncentration in ug/m^3

ncentration Posting in ug/m^3

ample Not Analyzed.

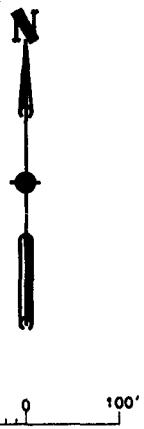


FIGURE 5–2

$$ – THINK VALUE ENGINEERING – $$

Revisions

Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.J.G.

Drawn by: J.A.H.

Checked by: R.J.G.

Reviewed by: X

Submitted by: Chief, GEOLOGY A Section

ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT

HIMCO DUMP SUPERFUND SITE

1998 SUPPLEMENTAL SITE INVESTIGATION
SOIL GAS ISOCONCENTRATION MAP
TOTAL CHLORINATED ETHENES

Plot Scale Ratio:
Design File: eh01tegiose-1.dgn
Date: JUNE 2002
Spec. No.: DACA 45
Contract No.: DACA 45
Drawing Code: X
Sheet reference number: X

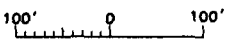
COMPUTER AIDED DESIGN & DRAFTING

B

A

2 1

FIGURE 5-3



on (11/98)
on (12/98)
Concentration in ug/m³
Concentration Posting in ug/m³
le. Sample Not Analyzed.

$$ - THINK VALUE ENGINEERING - $$

Revisions

Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.J.G.
Drawn by: J.A.H.
Checked by: R.J.G.
Reviewed by: X
Submitted by: Chief: GEOLOGY A Section

ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
1998 SUPPLEMENTAL SITE INVESTIGATION
SOIL GAS ISOCONCENTRATION MAP
TOTAL CHLORINATED ETHANES

Plot Scale Ratio: 100:1
Design File: eh01sgicea-1.dgn
Date: JUNE 2002
Spec. No.: DACA 45
Contract No.: DACA 45
Drawing Code: X
Sheet reference number: X

COMPUTER AIDED DESIGN & DRAFTING

B
A

2 1

1/98)
2/98)
In ug/m^3
Posting In ug/m^3
mple Not Analyzed.

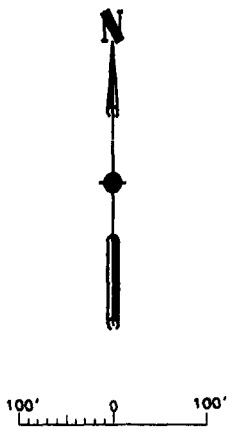


FIGURE 5-4

$$ – THINK VALUE ENGINEERING – $$

Revisions

Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

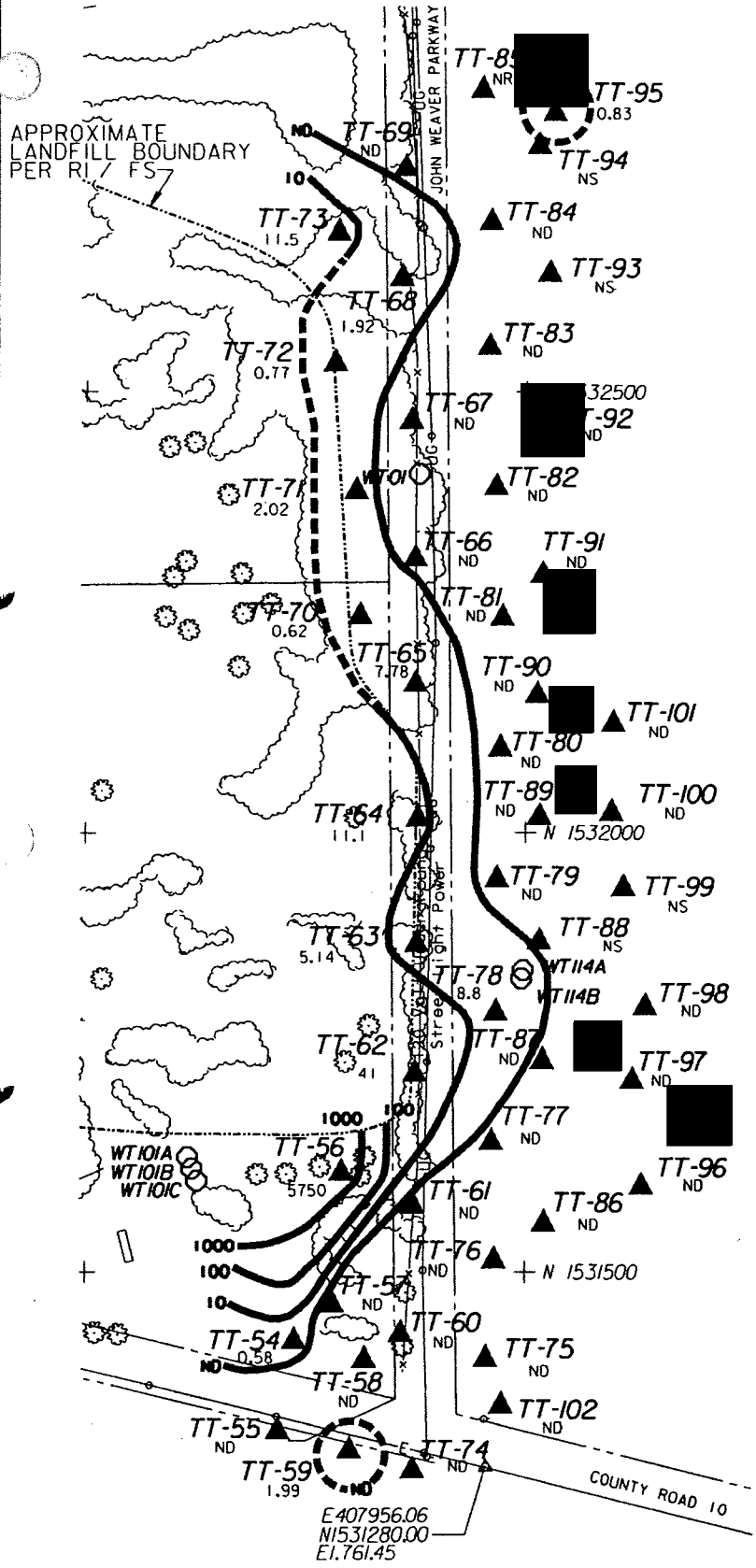
ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
1998 SUPPLEMENTAL SITE INVESTIGATION
SOIL GAS ISOCONCENTRATION MAP
VINYL CHLORIDE

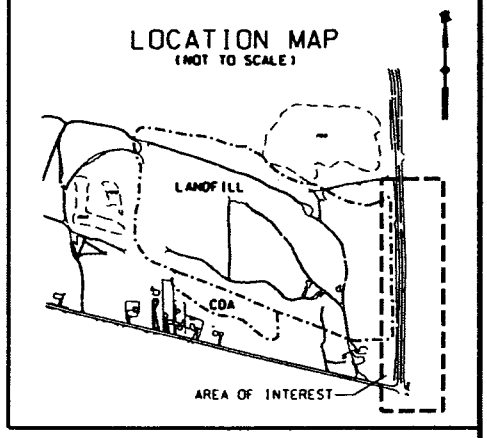
Designed by: R.J.G.	Plot Scale Ratio:	Date: JUNE 2002	Sheet reference number: X
Drawn by: J.A.H.	Design File: eh01\sgivc-1.dgn		
Checked by: R.J.G.	Spec. No.: DACA 45	Drawing Code: X	
Reviewed by: X	Contract No.: DACA 45		
Submitted by: Chief: GEOLOGY A Section			

COMPUTER AIDED DESIGN & DRAFTING

B
A

2 1





N

LEGEND

WT101A	Monitoring Well
TT-54	Soil Gas Sampling Location
10	Total BTEX Concentration in ug/m^3
150	Total BTEX Concentration Posting in ug/m^3
NS	Not Sampled
ND	Not Detected at the Stated Reporting Limit
NR	Not Reported
	Outline of Residential Building

NOTES

1. Compounds reported by the laboratory and shown in this figure include benzene, toluene, ethyl benzene, m,p-xylene and o-xylene.

200' 0 200'

FIGURE 5-5

$S - THINK VALUE ENGINEERING - $S

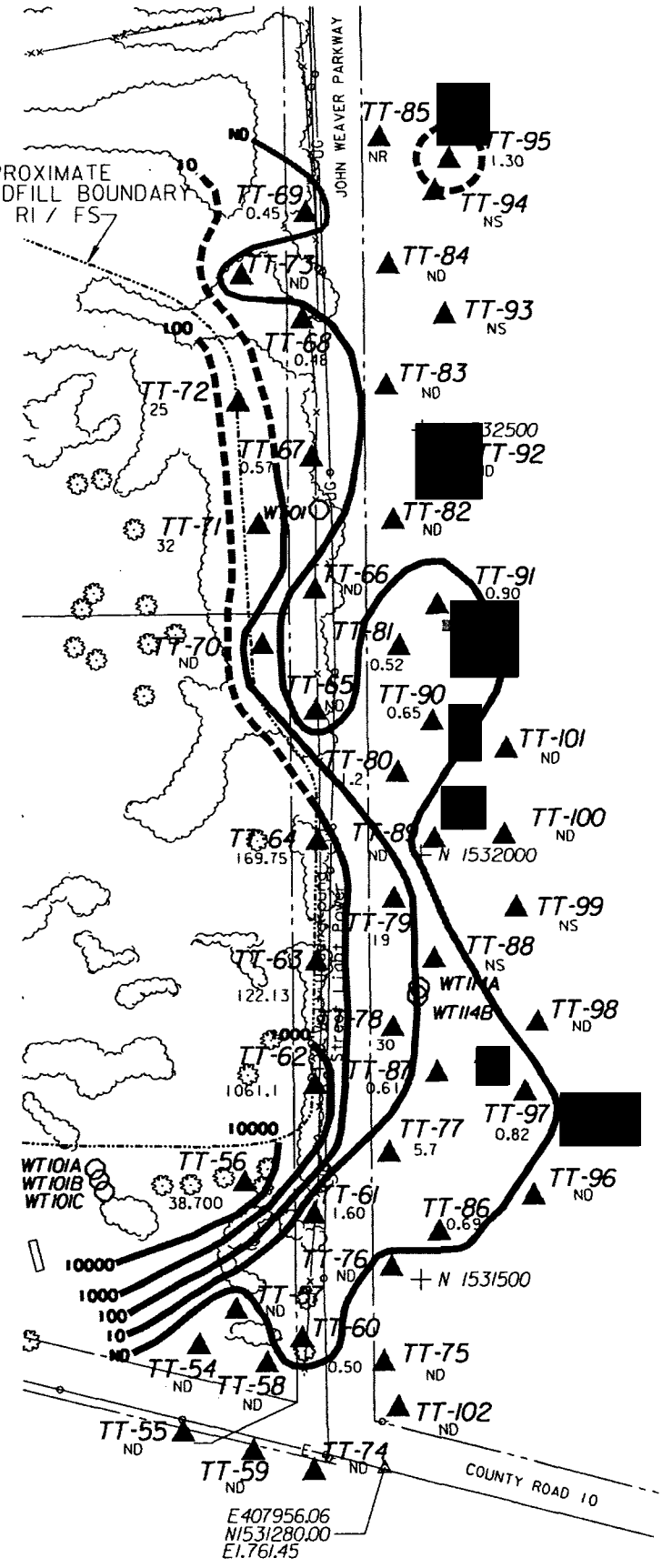
Revisions

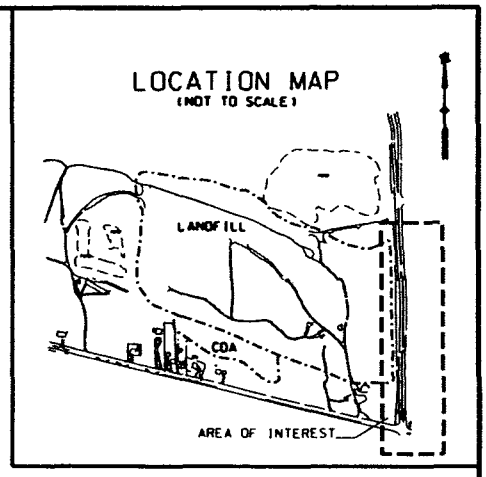
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA NEBRASKA

ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
1999 SUPPLEMENTAL SITE INVESTIGATION
SOIL GAS ISOCONCENTRATION MAP
TOTAL BTEX

Designed by R.J.G.	Plot Scale Ratio X	Date JUNE 2002	Sheet reference number
Drawn by J.A.H.	Design File sh01gelea5a.dgn		
Checked by R.J.G.	Spec. No. DACA 45	Drawing Code X	X
Reviewed by	Contract No. DACA 45		
Submitted by Chief GEOLOGY & Section			





LEGEND

○ WT101A	Monitoring Well
▲ TT-54	Soil Gas Sampling Location
10	Total Chlorinated Ethene Concentration in ug/m^3
▲150	Total Chlorinated Ethene Concentration Posting in ug/m^3
▲NS	Not Sampled
▲ND	Not Detected at the Stated Reporting Limit
▲NR	Not Reported
	Outline of Residential Building

NOTES

1. Chlorinated ethene compounds reported by the laboratory and shown in this figure include vinyl chloride, 1,1-dichloroethene, trans-1,2-dichloroethene, trichloroethene, tetrachloroethene and cis-1,2-dichloroethene.

200' 0 200'

FIGURE 5-6

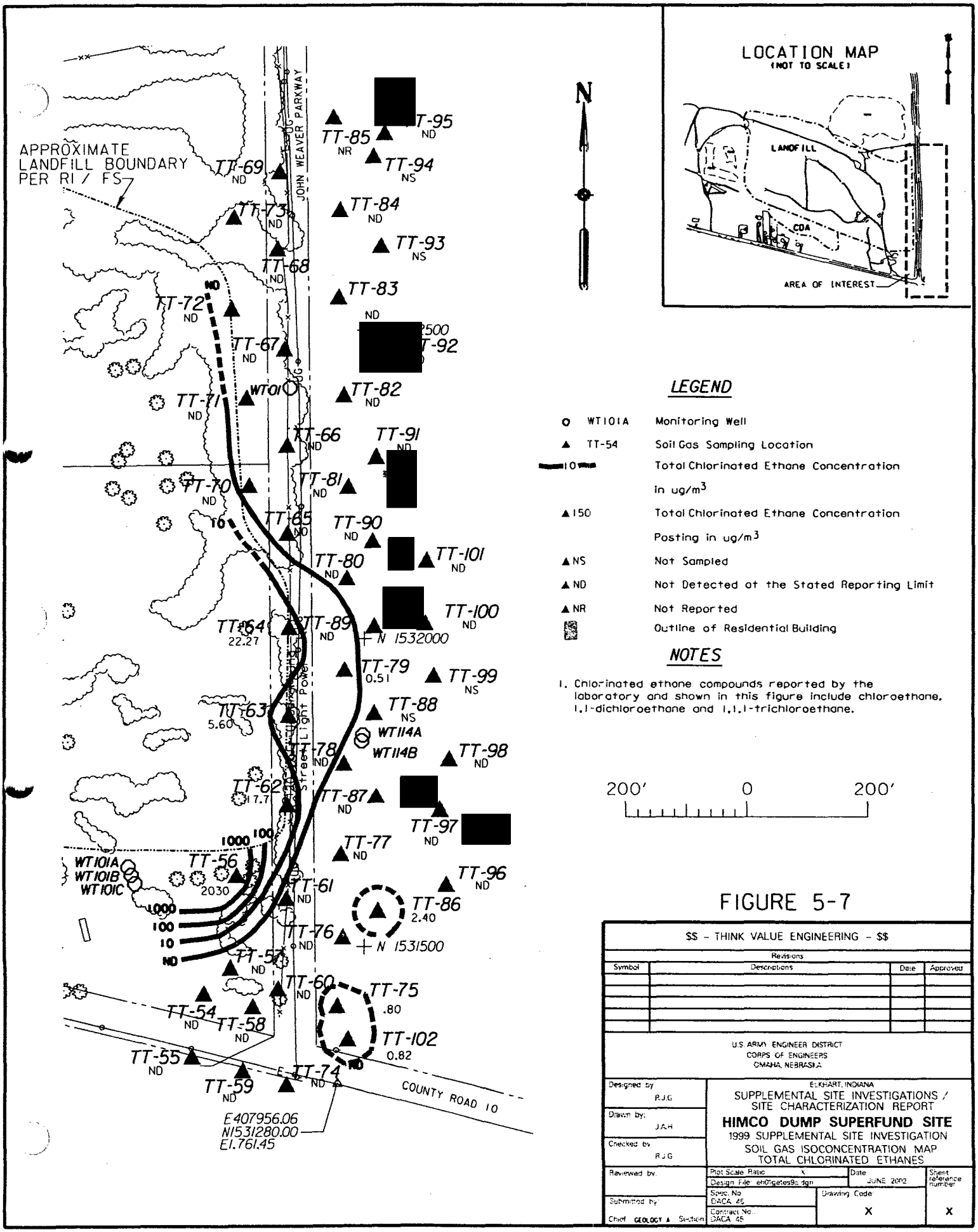
$S - THINK VALUE ENGINEERING - $S

Revisions			
Symbol	Descriptions	Date	Approved

US ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
1999 SUPPLEMENTAL SITE INVESTIGATION
SOIL GAS ISOCONCENTRATION MAP
TOTAL CHLORINATED ETHENES

Designed by R.J.G.	Plot Scale Ratio: X	Date: JUNE 2002	Sheet reference number
Drawn by J.A.H.	Design File: eh01gate05a.dgn		
Checked by R.J.G.	Spec No.: DACA 45	Drawing Code: X	X
Reviewed by	Contract No.: DACA 45		
Submitted by Chief GEOLOGY & Section			



LEGEND

○ WT101A	Monitoring Well
▲ TT-54	Soil Gas Sampling Location
10	Total Chlorinated Ethane Concentration in ug/m^3
▲150	Total Chlorinated Ethane Concentration Posting in ug/m^3
▲NS	Not Sampled
▲ND	Not Detected at the Stated Reporting Limit
▲NR	Not Reported
	Outline of Residential Building

NOTES

1. Chlorinated ethane compounds reported by the laboratory and shown in this figure include chloroethane, 1,1-dichloroethane and 1,1,1-trichloroethane.

FIGURE 5-7

$$ - THINK VALUE ENGINEERING - $$

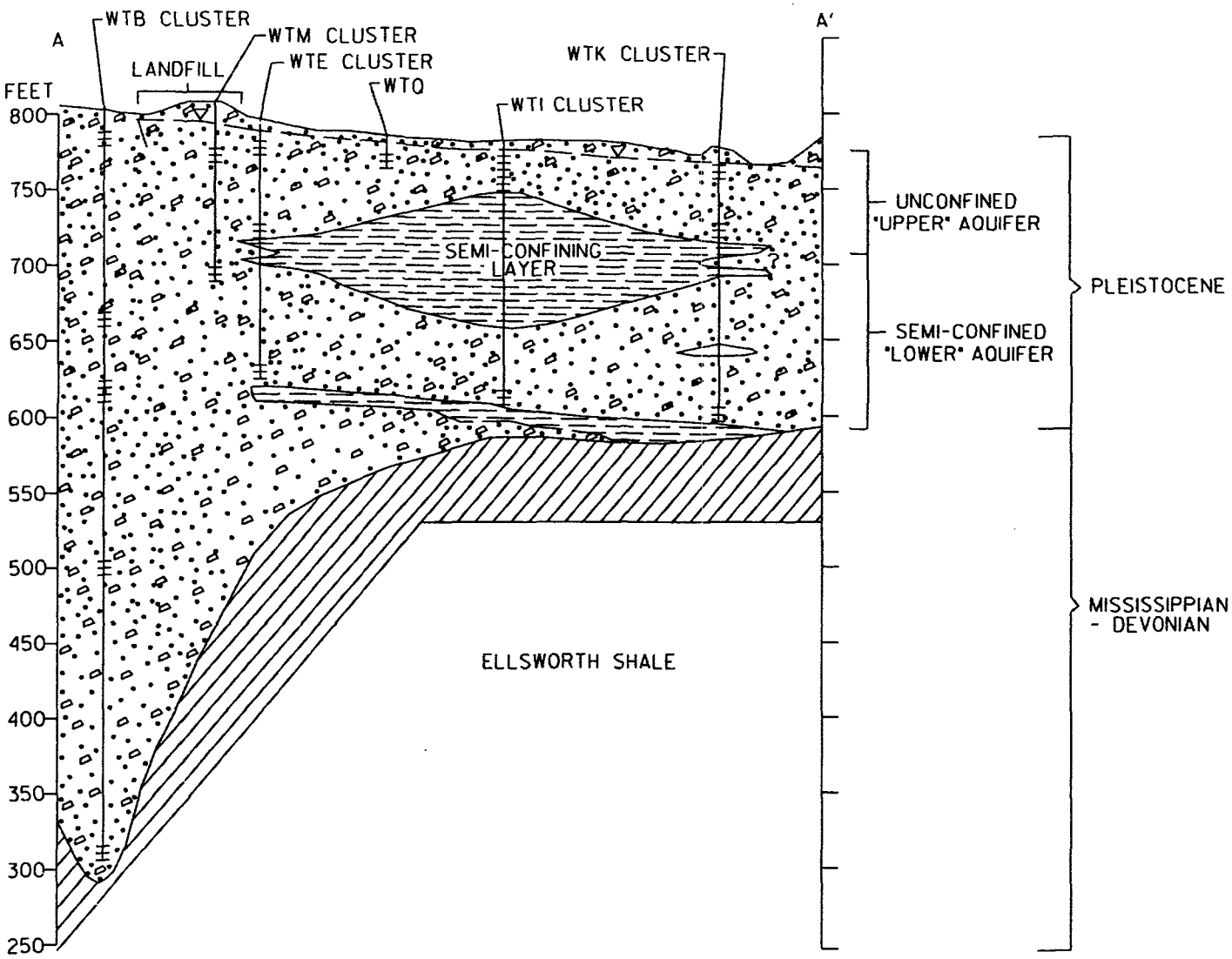
Revisions

Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
1999 SUPPLEMENTAL SITE INVESTIGATION
SOIL GAS ISOCONCENTRATION MAP
TOTAL CHLORINATED ETHANES

Designed by: RJG	Plot Scale: Ratio X	Date: JUNE 2002	Sheet reference number
Drawn by: JAH	Design File: eh01gate59.dgn		
Checked by: RJG	Spec. No: DACA 45	Drawing Code: X	X
Reviewed by:	Contract No.: DACA 45		
Submitted by: Chief GEOLOGY & Section			



0 1000 2000 3000 4000 5000 FEET

0 300 600 900 1200 1500 METERS

VERTICAL EXAGGERATION X 18 DATUM IS SEA LEVEL

EXPLANATION

- SAND AND GRAVEL
- CLAY
- BEDROCK
- POTENTIOMETRIC SURFACE
- WTM — MONITORING WELL OR WELL CLUSTER AND SCREENED INTERVAL(S)

(MODIFIED FIGURE FROM DUWELIUS AND SILCOX, 1991)

FIGURE 7-1

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
REGIONAL STRATIGRAPHIC / GEOLOGIC CROSS SECTION

Designed by: R.J.G.			
Drawn by: J.A.H.			
Checked by: R.J.G			
Reviewed by:	Plot Scale Ratio: X	Date: SEPTEMBER 2002	Sheet reference number:
	Design File: eh01geofig7 1cse.dgn		
Submitted by: Chief: GEOLOGY A Section	Spec. No.: DACA 45	Drawing Code: X	X
	Contract No.: DACA 45		

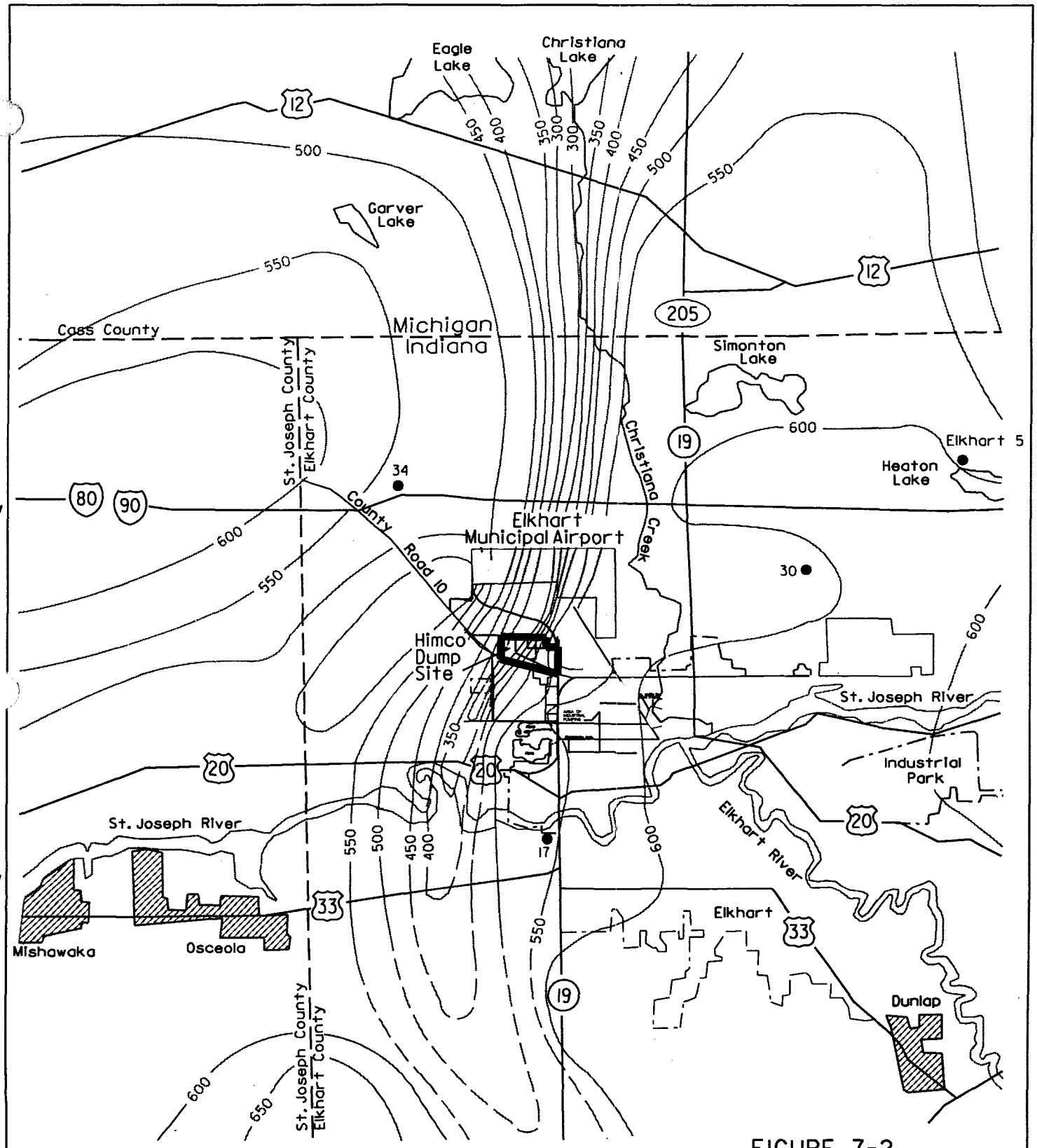
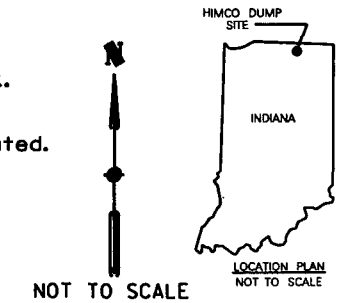


FIGURE 7-2

LEGEND

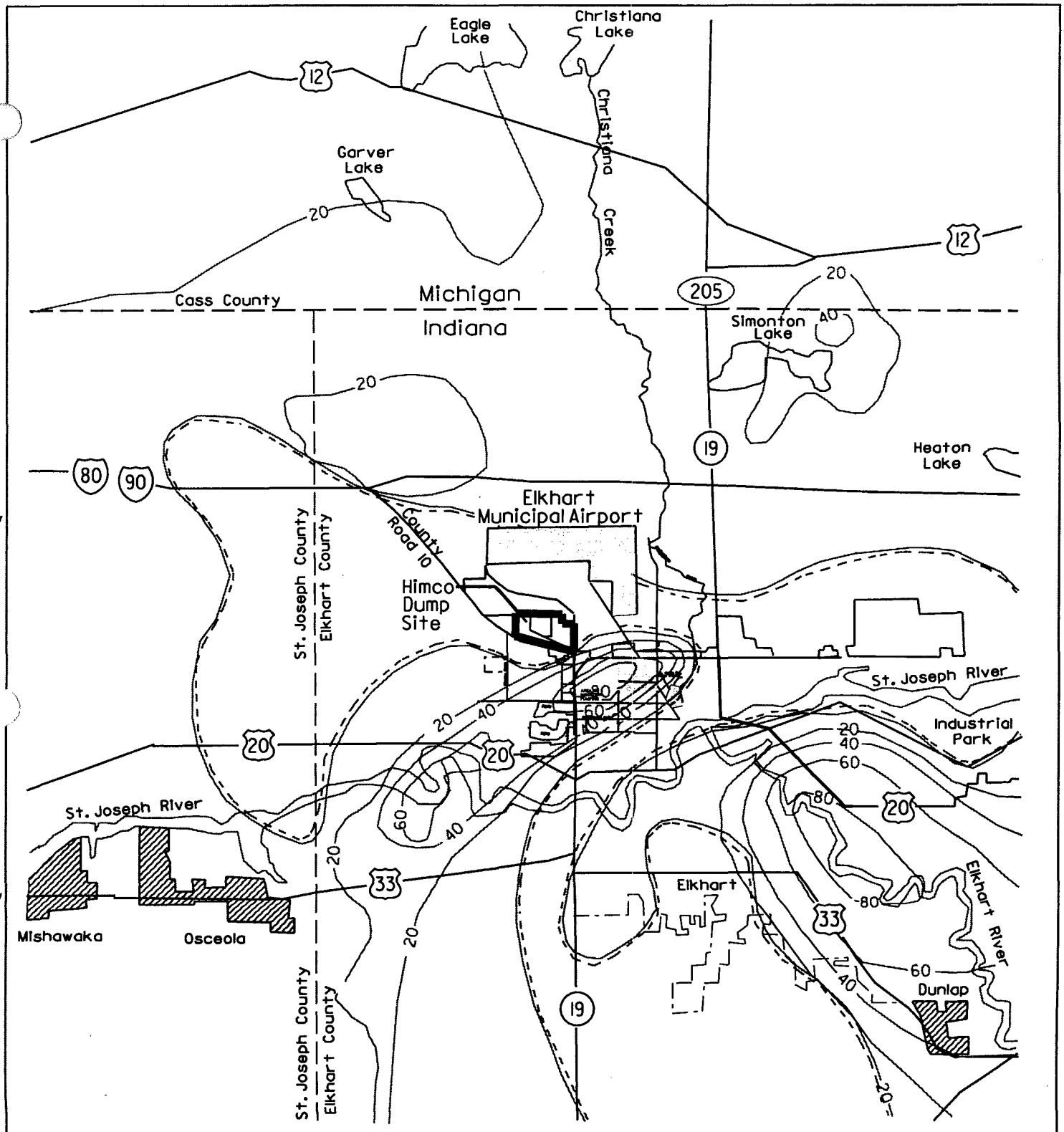
——— 500 — — Elevation of bedrock.
Interval 50 feet.
Dashed where estimated.
NGVD of 1929.

(MODIFIED FIGURE FROM IMBRIGIOTTA AND MARTIN, 1981)



U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.J.G.	ELKHART, INDIANA
Drawn by: J.A.H.	SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
Checked by: R.J.G.	**HIMCO DUMP SUPERFUND SITE**
Reviewed by:	BEDROCK TOPOGRAPHY IN VICINITY OF HIMCO DUMP SITE
Submitted by:	Plot Scale Ratio: X; Date: SEPTEMBER 2002; Sheet reference number:
Chief: GEOLOGY & Section	Design File: eh01geofig7-2.dgn; Spec. No.: DACA 45; Drawing Code: X; Contract No.: DACA 45; X



LEGEND

CONFINING BED ABSENT

—40— LINE OF EQUAL THICKNESS INTERVAL 20 FEET

(MODIFIED FIGURE FROM IMBRIGIOTTA AND MARTIN, 1981)

N

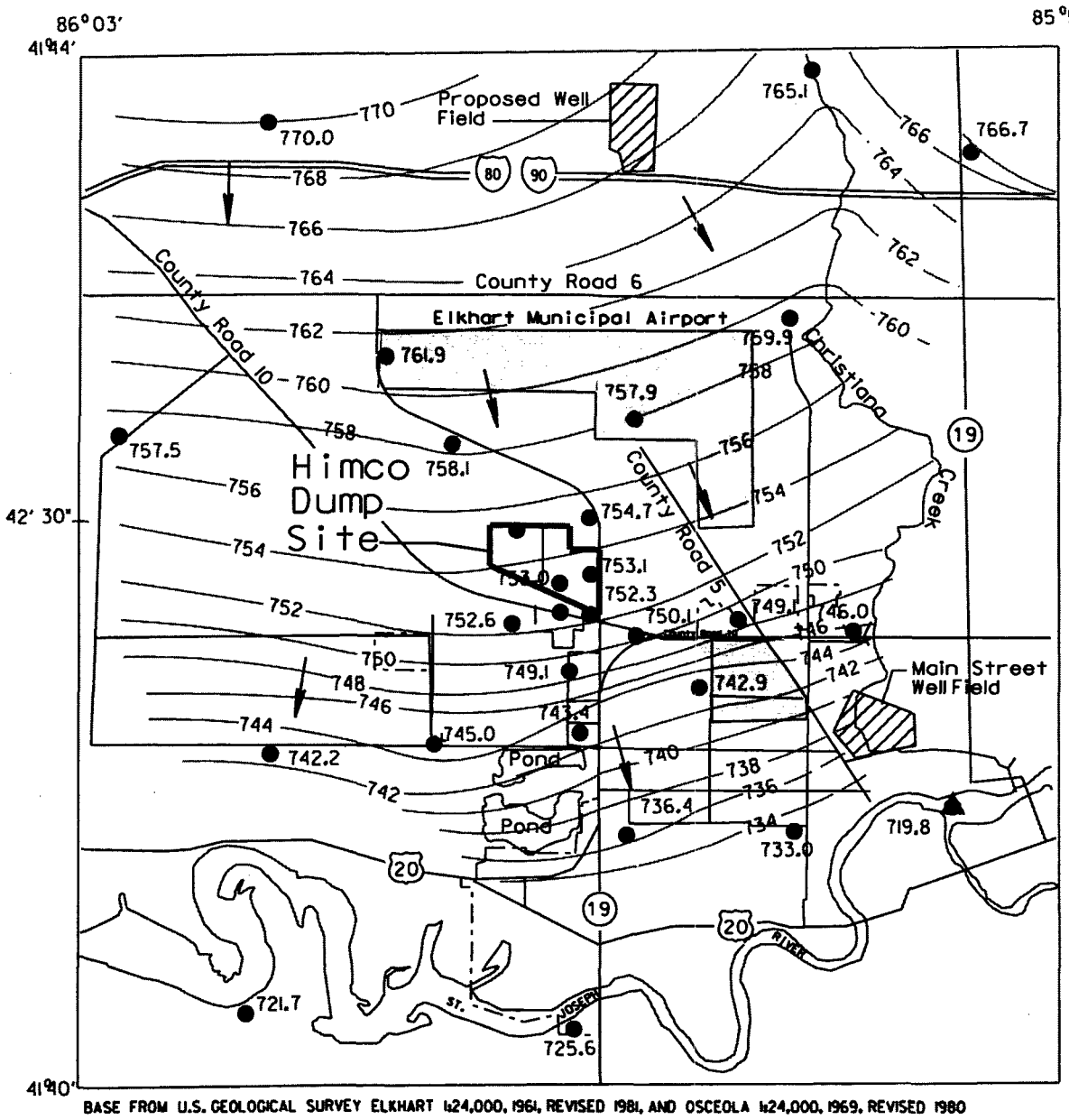
NOT TO SCALE

LOCATION PLAN
NOT TO SCALE

FIGURE 7-3

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.J.G.	ELKHART, INDIANA
Drawn by: J.A.H.	SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
Checked by: R.J.G.	**HIMCO DUMP SUPERFUND SITE**
Reviewed by:	THICKNESS AND EXTENT OF CLAY SEMI-CONFINING LAYER
Submitted by: Chief: GEOLOGY & Section	Plot Scale Ratio: X; Date: SEPTEMBER 2002; Design File: eh01geofig7-4.dgn; Sheet reference number: X; Spec. No.: DACA 45; Drawing Code: X; Contract No.: DACA 45



BASE FROM U.S. GEOLOGICAL SURVEY ELKHART 1:24,000, 1961, REVISED 1981, AND OSCEOLA 1:24,000, 1969, REVISED 1980

N

NOT TO SCALE

LOCATION PLAN
NOT TO SCALE

EXPLANATION

——766— — — WATER-LEVEL CONTOUR: SHOWS ALTITUDE OF WATER LEVEL. DASHED WHERE APPROXIMATELY LOCATED. CONTOUR INTERVAL 2 FEET. DATUM IS SEA LEVEL.

DIRECTION OF FLOW.

745.0 ● MONITORING WELL: NUMBER IS WATER-LEVEL ALTITUDE IN FEET ABOVE SEA LEVEL.

▲ STREAMFLOW-GAGING STATION: NUMBER IS RIVER STAGE IN FEET ABOVE SEA LEVEL.

(MODIFIED FIGURE FROM DUWELIUS AND SILCOX, 1990)

FIGURE 7-4

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA			
Designed by: R.J.G.	ELKHART, INDIANA SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT **HIMCO DUMP SUPERFUND SITE** WATER LEVELS AND DIRECTION OF FLOW IN THE UNCONFINED AQUIFER, APRIL 1986		
Drawn by: J.A.H.			
Checked by: R.J.G.			
Reviewed by:	Plot Scale Ratio: X	Date: SEPTEMBER 2002	Sheet reference number:
	Design File: eh01geofig7-6.dgn		
Submitted by:	Spec. No.: DACA 45	Drawing Code: X	X
Chief: GEOLOGY & Section	Contract No.: DACA 45		

Figure 7-5
Water Levels vs Date - WT101 Cluster

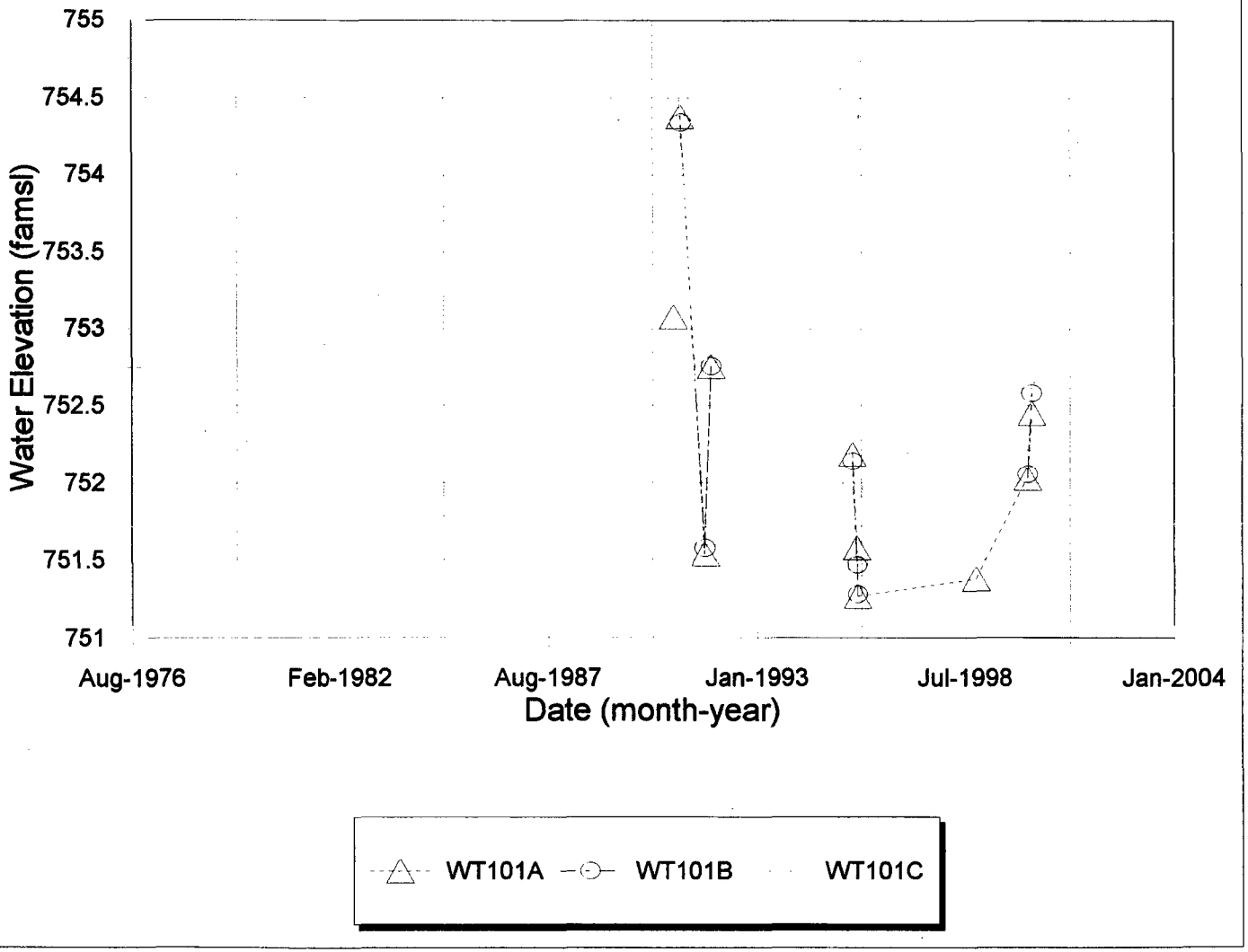


Figure 7-6
Water Levels vs Date - WTB Cluster

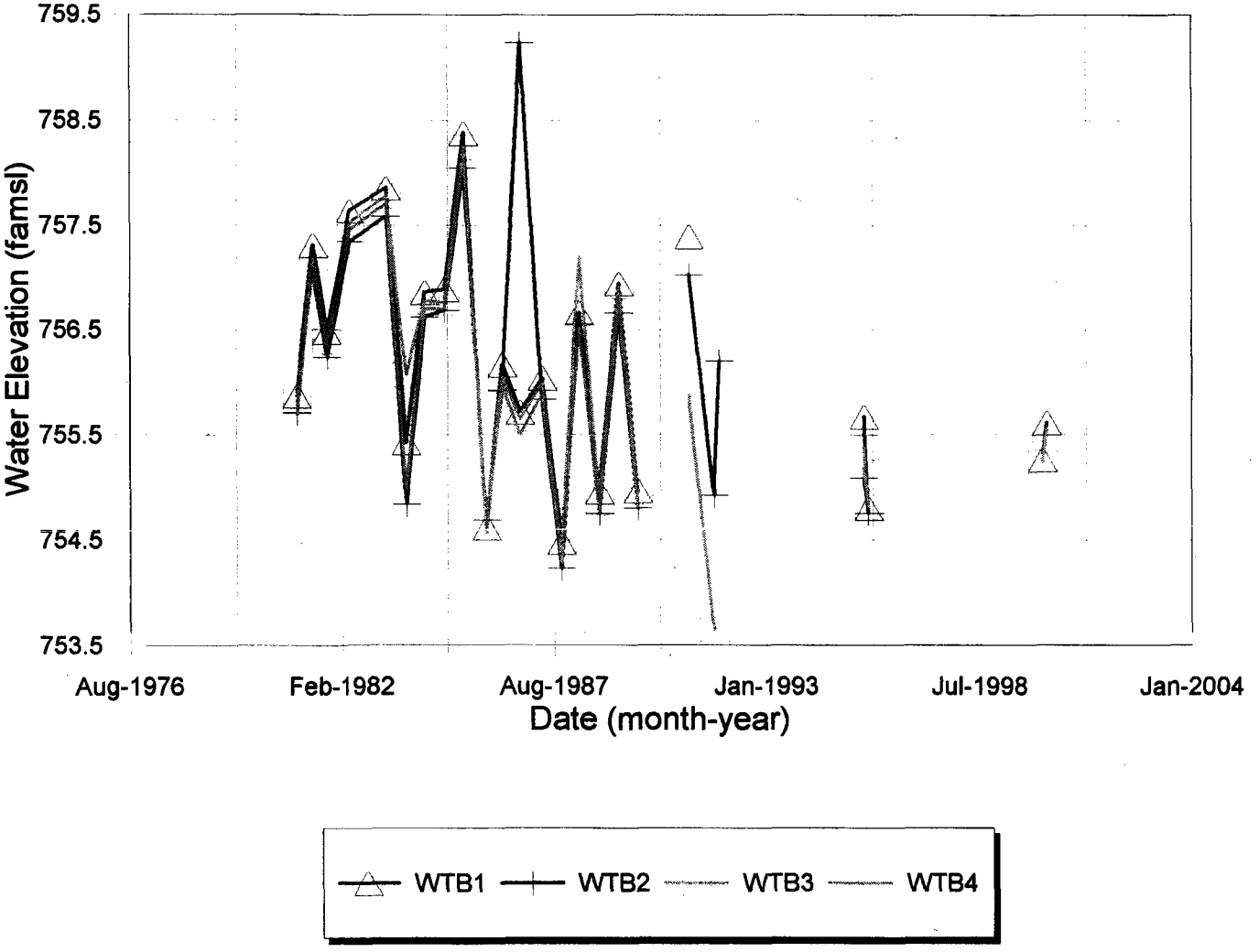


Figure 7-7
Water Levels vs Date - WTE Cluster

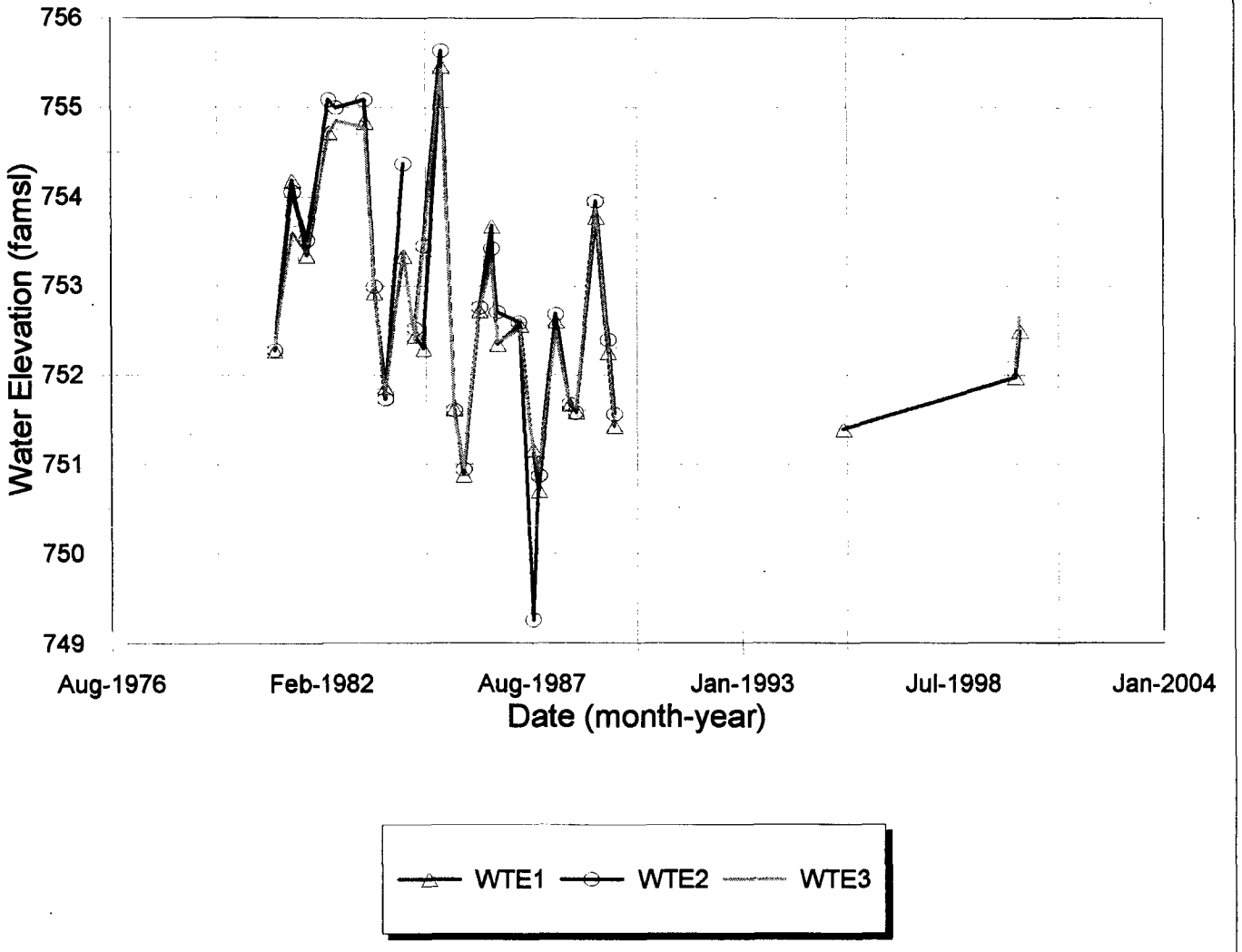
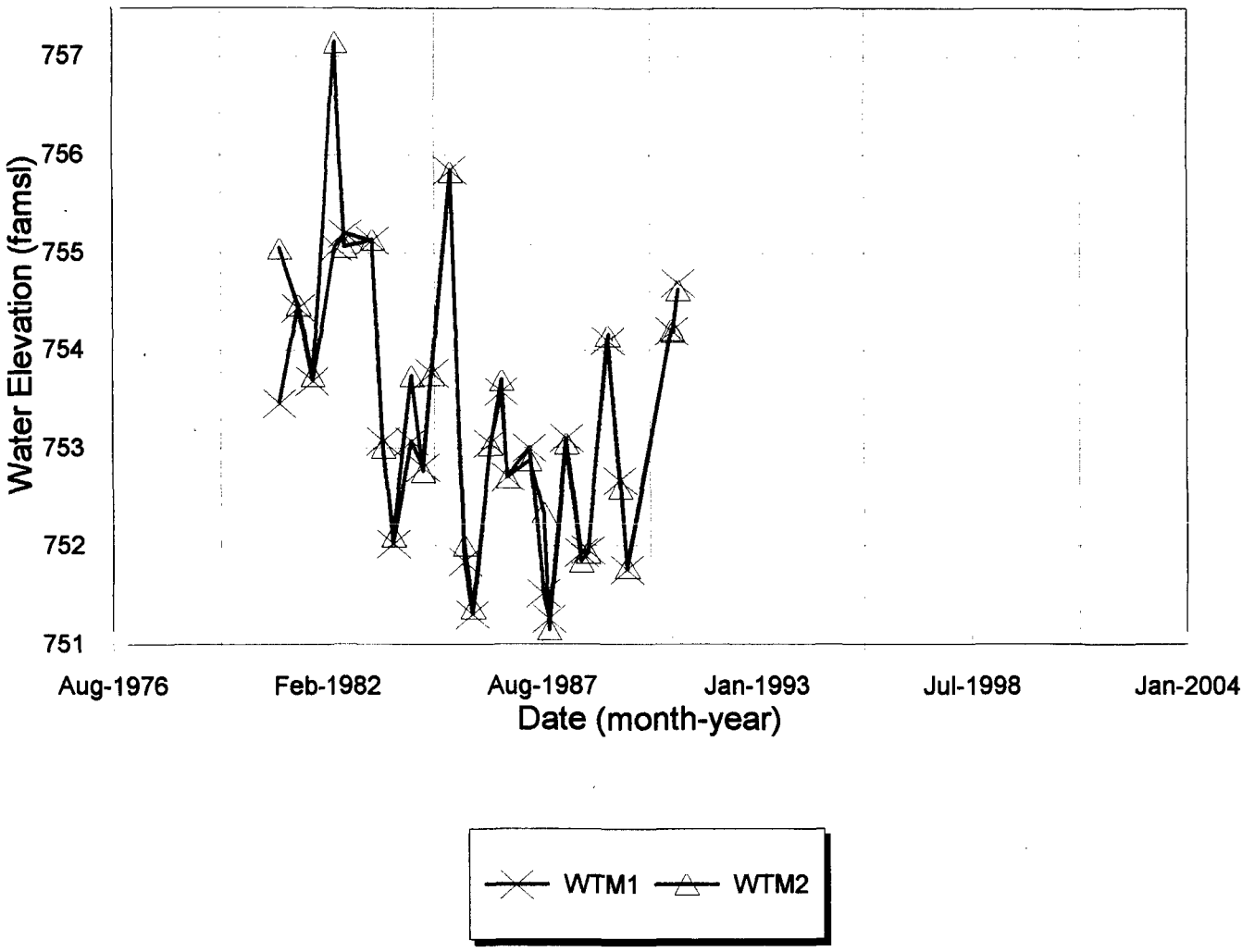


Figure 7-8
Water Levels vs Date - WTM Cluster



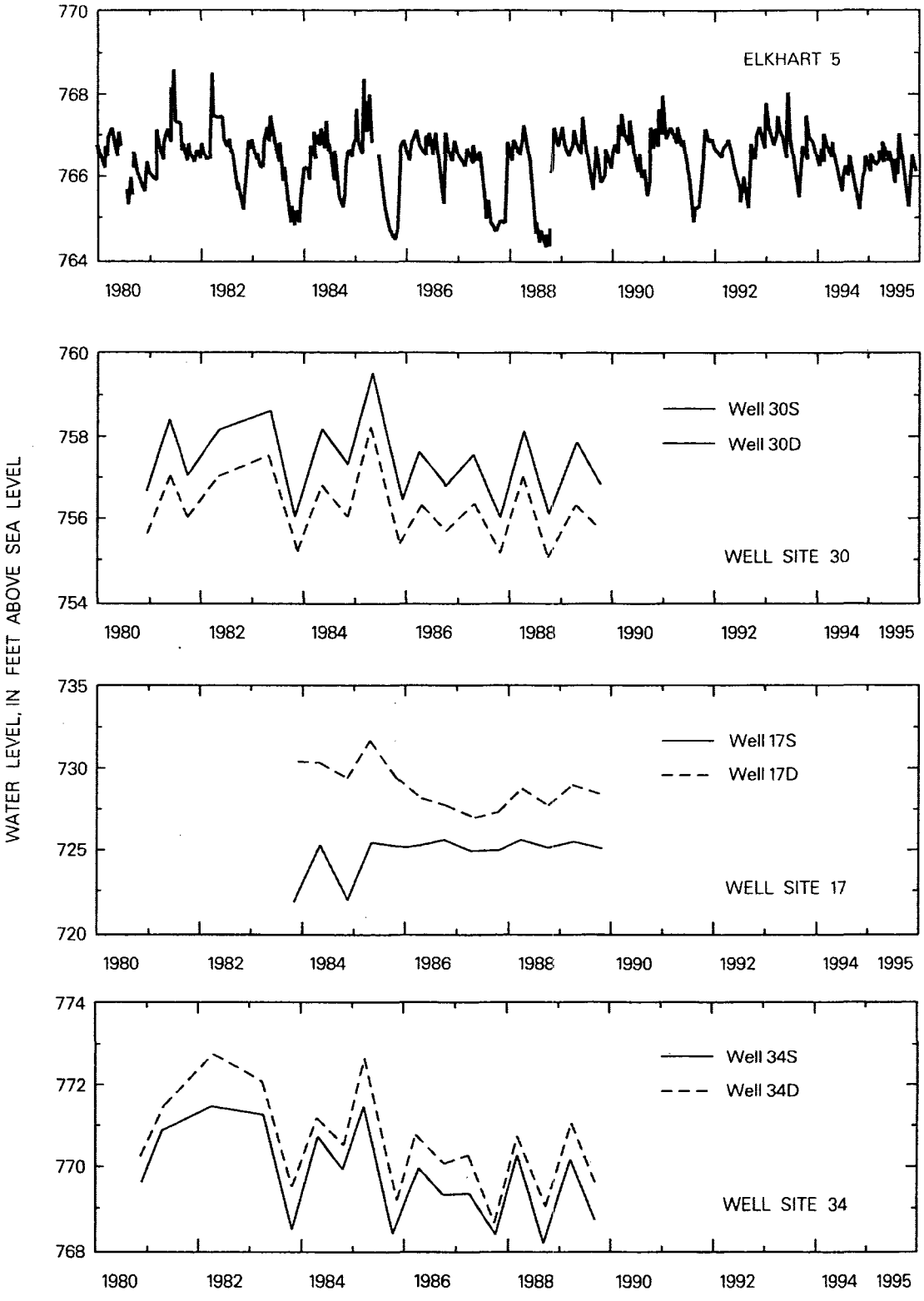


FIGURE 7-9

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.J.G.
Drawn by: J.A.H.
Checked by: R.J.G.
Reviewed by:
Submitted by:
Chief, [illegible] Section

ELKHART, INDIANA
SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT
HIMCO DUMP SUPERFUND SITE
OBSERVATION WELL HYDROGRAPHS
ELKHART COUNTY, INDIANA

Plot Scale Ratio: X
Design File: eh01geohydrog.dgn
Date: SEPTEMBER 2002
Spec. No.: DACA 45
Contract No.: DACA 45
Drawing Code: X
Sheet reference number: X

Figure 7-10
SEC Concentrations vs Date - WTE3

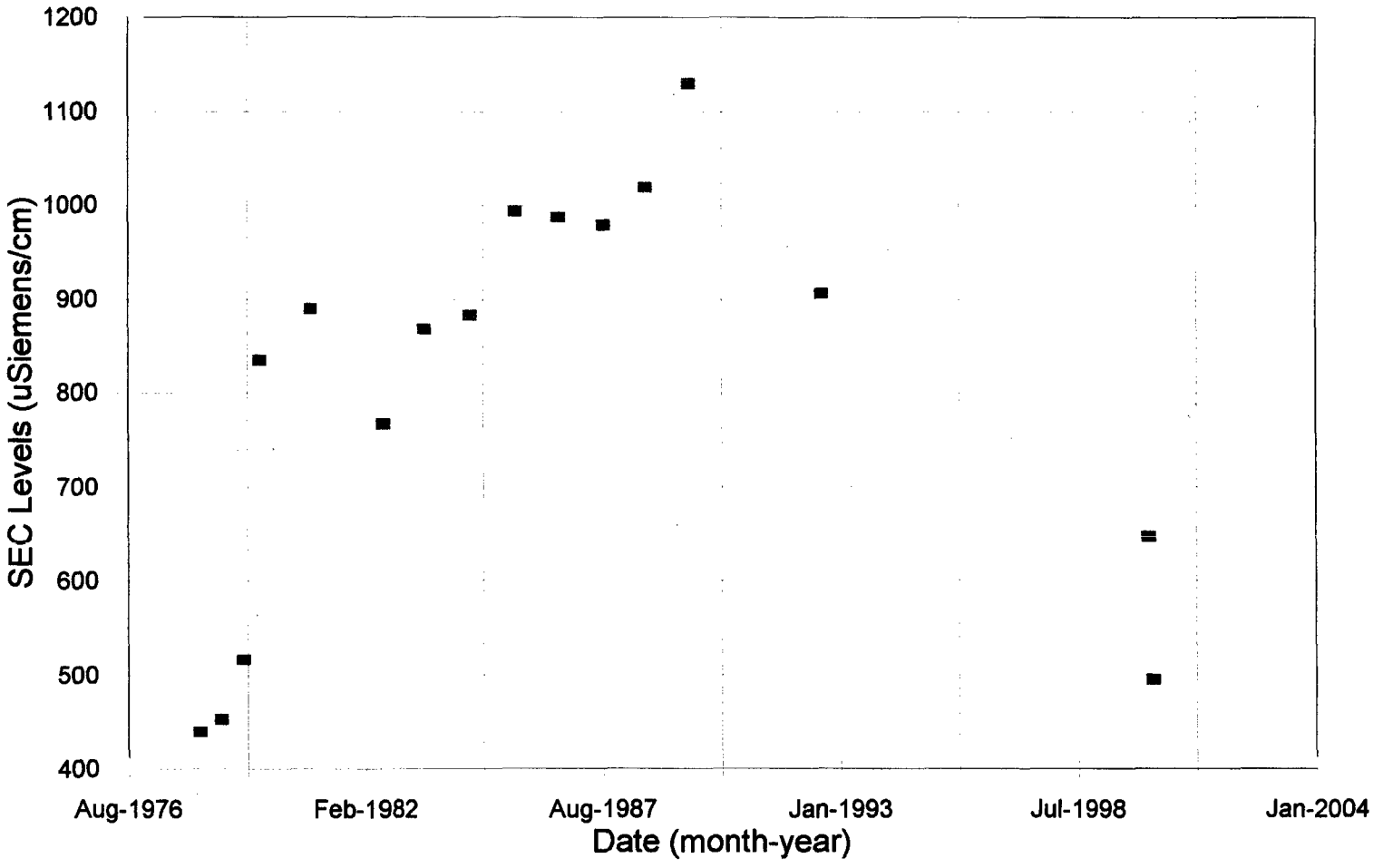


Figure 7-11
Bromide vs Date - WTM1 -Lower Aquifer

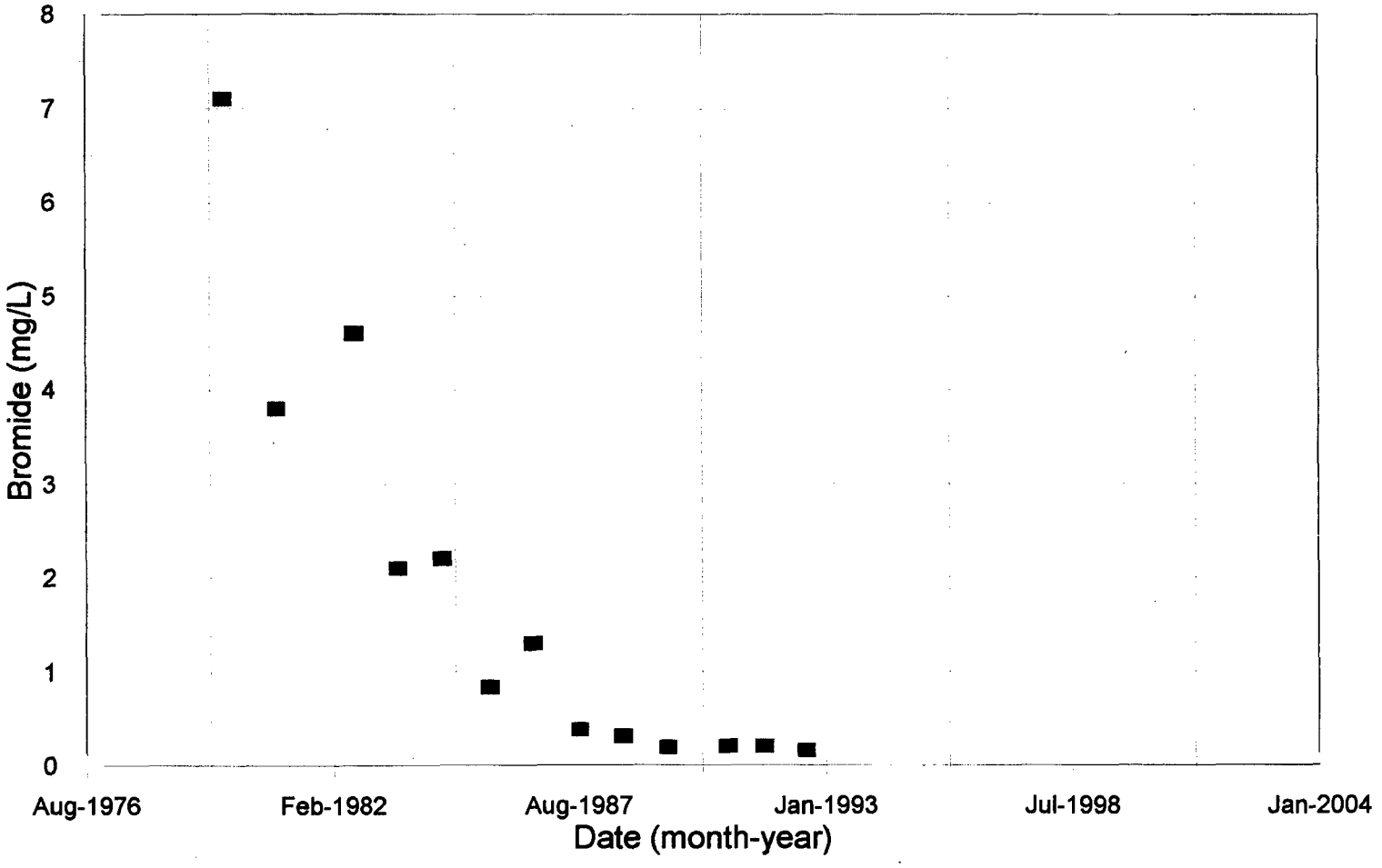


Figure 7-12
Bromide vs Date -WTM2 - Upper Aquifer

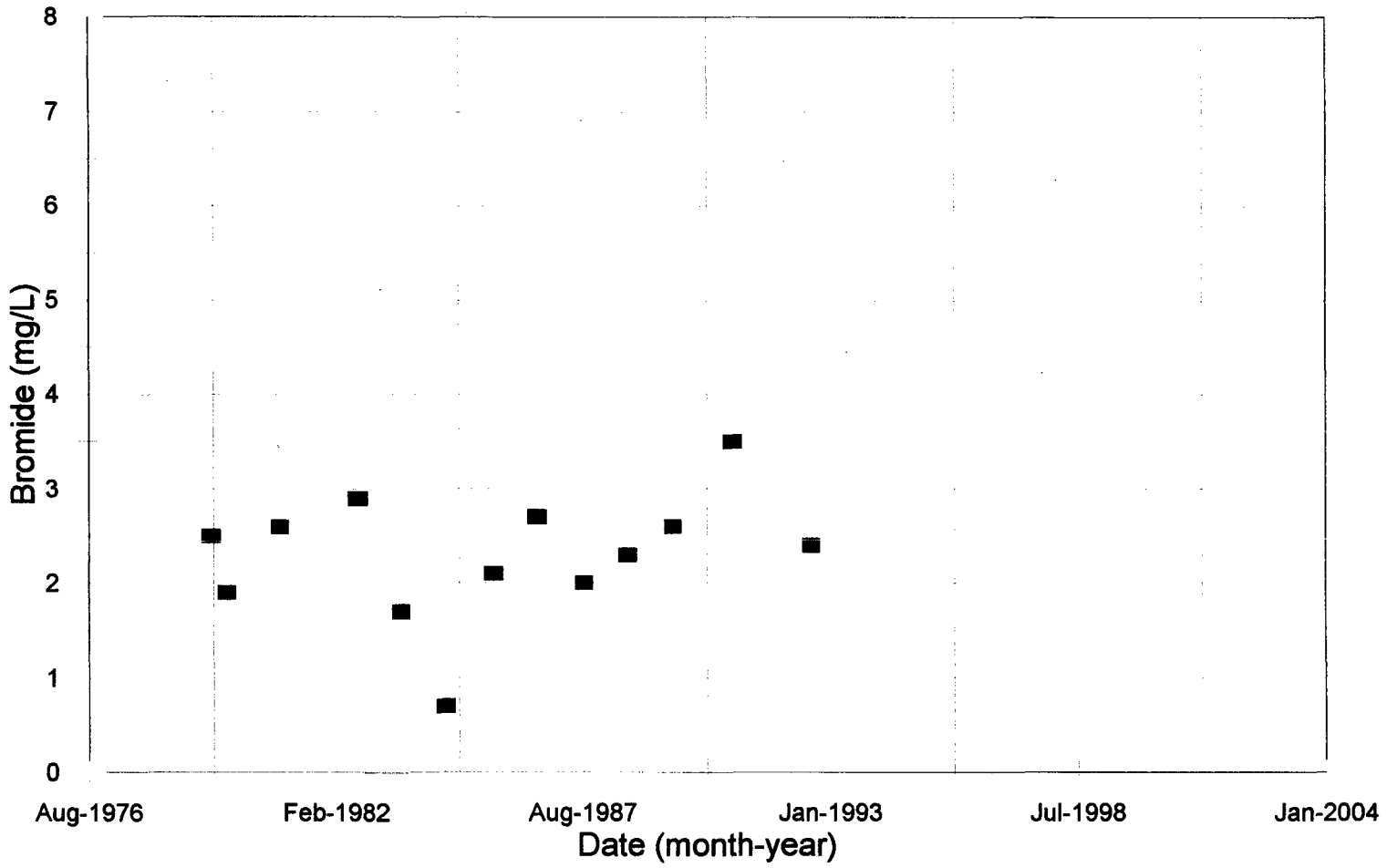


Figure 7-13
Bromide vs Date-WTE1-Upper Aquifer

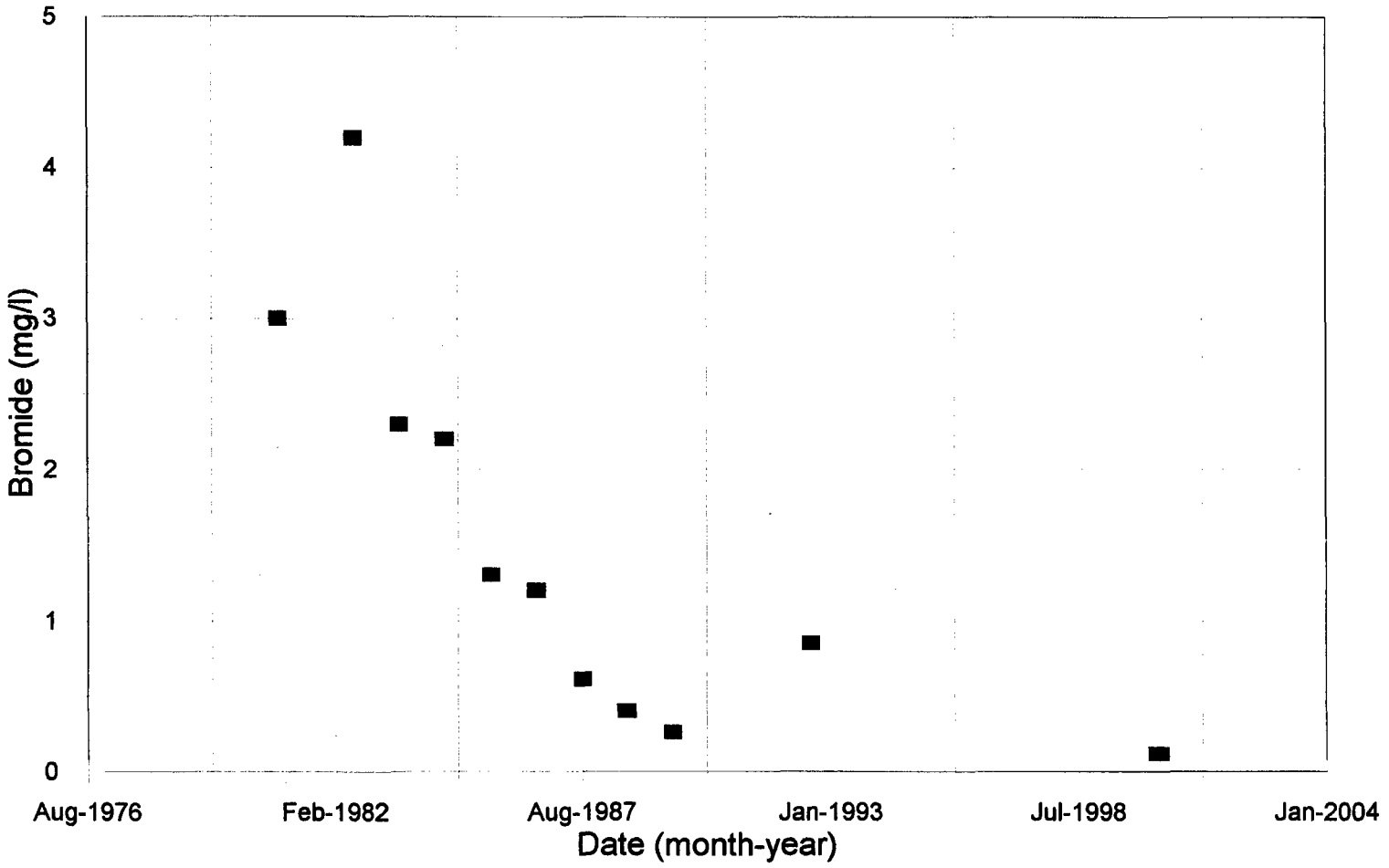


Figure 7-14
Bromide vs Date-WTE2-Water Table Well

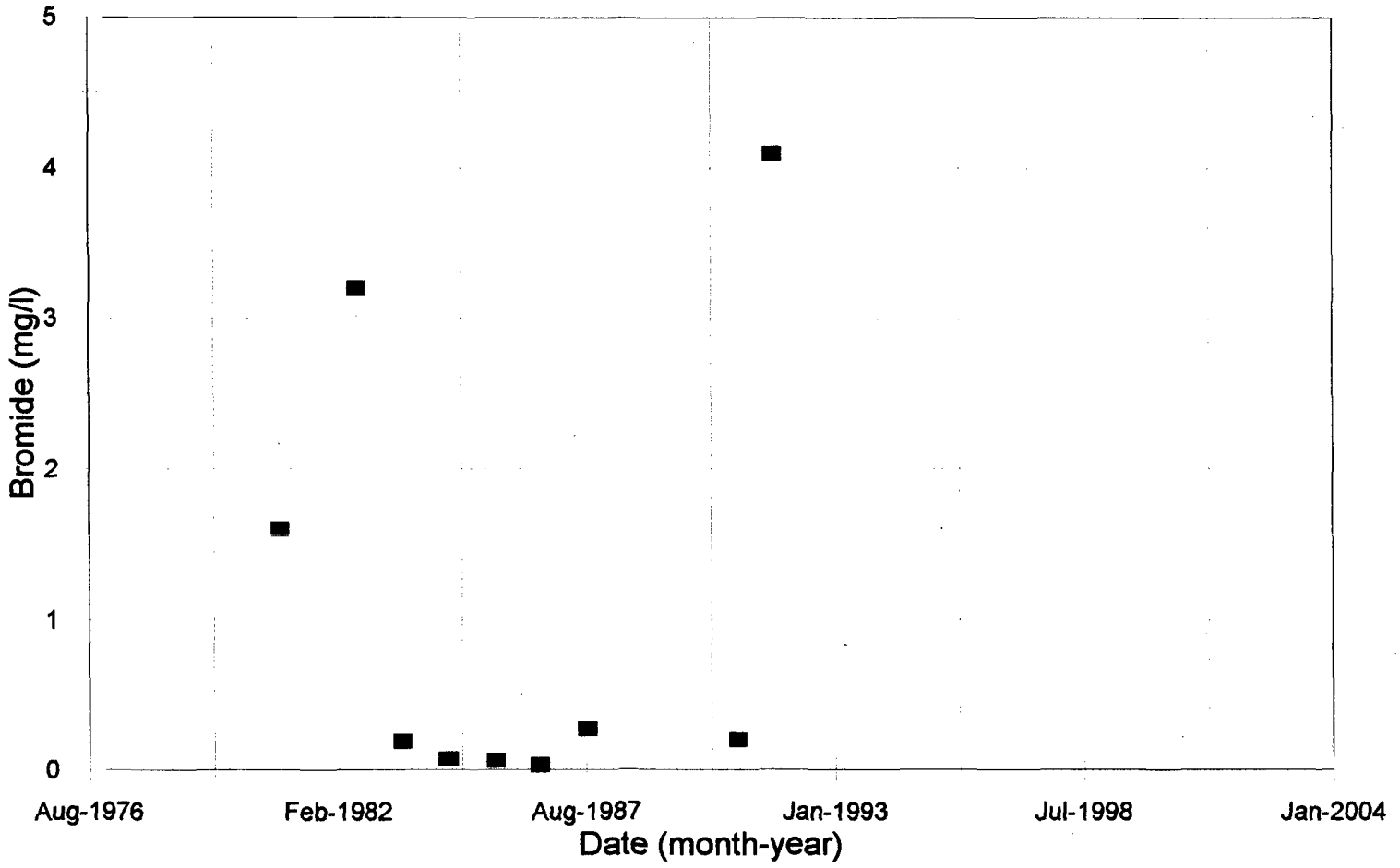


Figure 7-15
Bromide vs Date-WTE3-Lower Aquifer

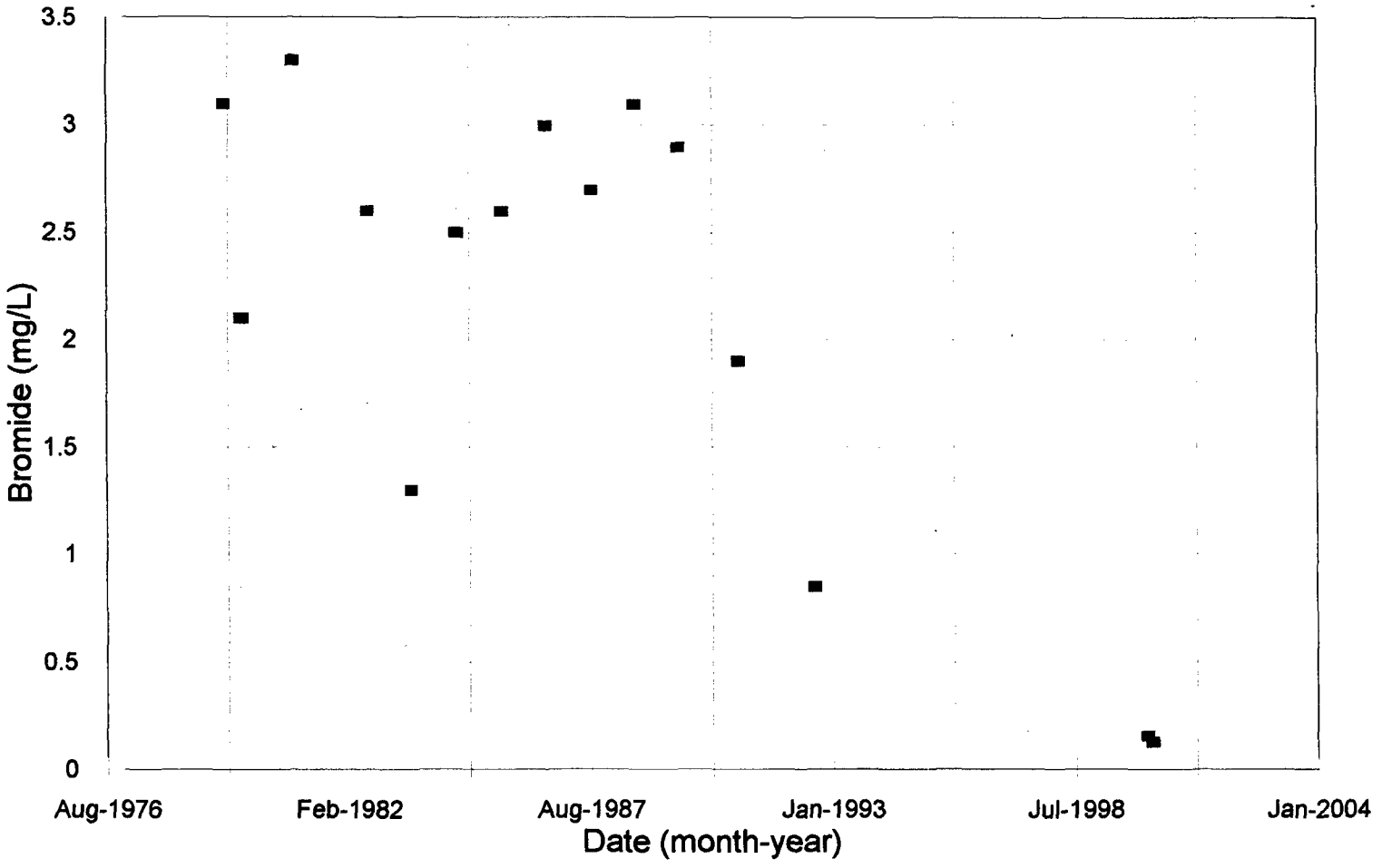


Figure 7-16
Iron vs Date-WTE3-Lower Aquifer

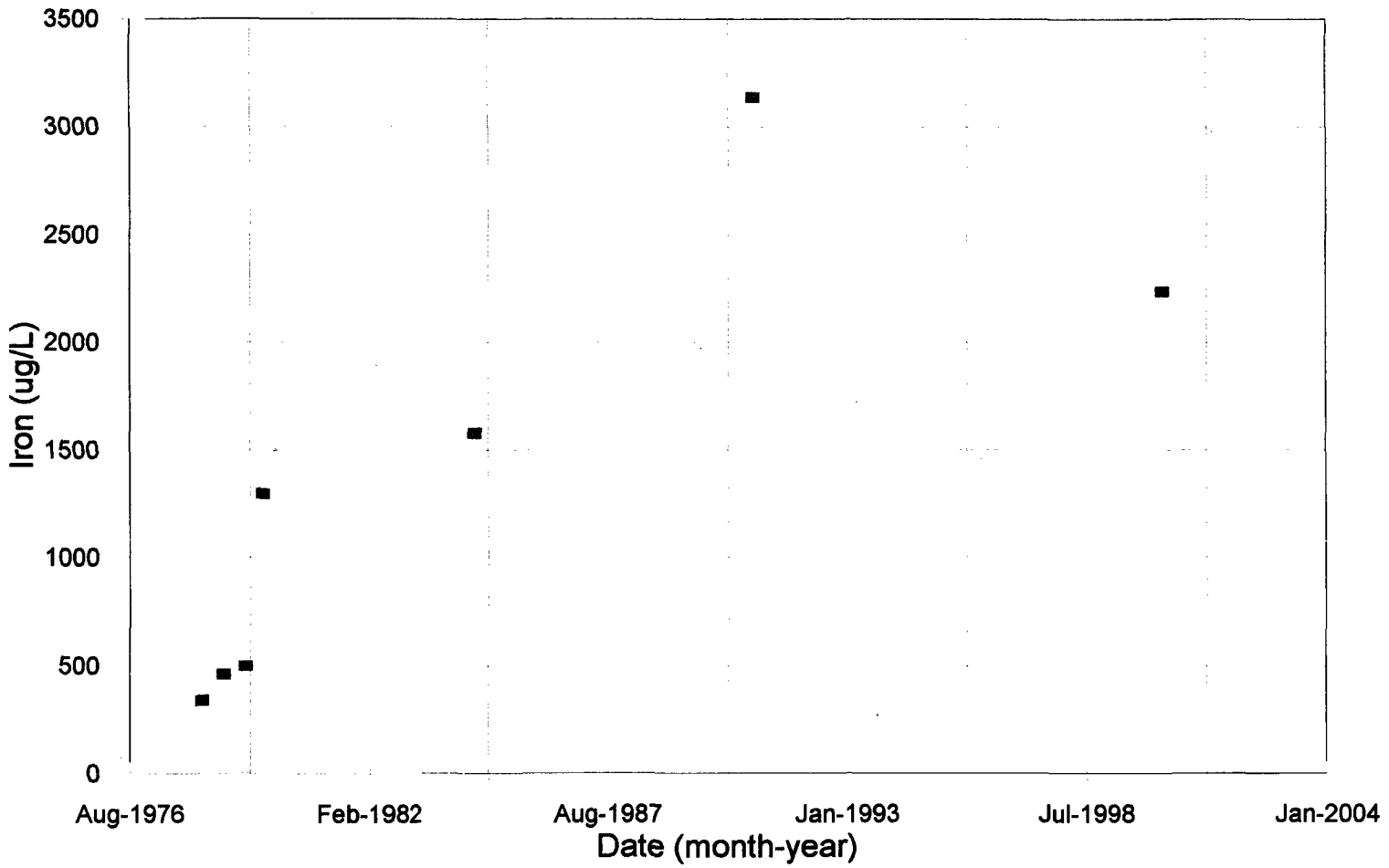
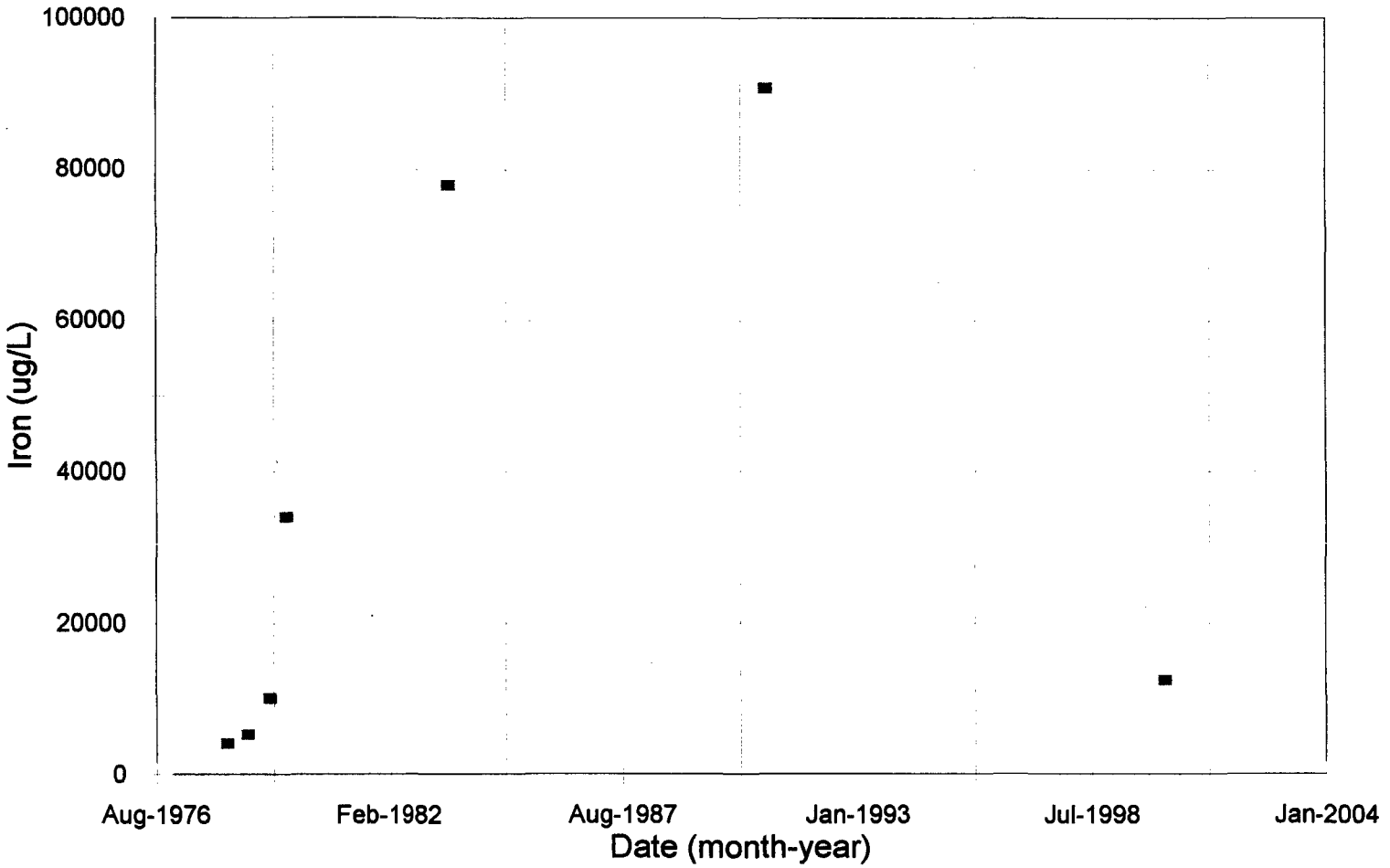


Figure 7-17
Sodium vs Date - WTE3 - Lower Aquifer



$$ - THINK VALUE ENGINEERING - $$

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

Designed by: R.J.G.

Drawn by: J.A.H.

Checked by: R.J.G.

Reviewed by:

Submitted by:
Chief: GEOLOGY A Section

ELKHART, INDIANA

SUPPLEMENTAL SITE INVESTIGATIONS / SITE CHARACTERIZATION REPORT

HIMCO DUMP SUPERFUND SITE

BROMIDE CONCENTRATIONS IN GROUND WATER IN 1980, 1988, AND 2000

Plot Scale Ratio: X
Design File: eh01geomulicou.dgn
Date: OCTOBER 2002
Sheet reference number: X
Spec. No.: DACW 45
Drawing Code: X
Contract No.: DACW 45

A

IMPUTER
IDED
DESIGN &
DRAFTING

Figure 8-1
Human Health Conceptual Site Model